

TU EnviroDIY Monitoring Station Manual V1.1

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Introduction

Created by Stroud Water Research Center, EnviroDIY is a community that shares do-it-yourself ideas for environmental science and monitoring. The vision of EnviroDIY is that, by sharing ideas and experiences, the EnviroDIY community will result in open-source hardware and software solutions for observing the environment that are low cost, easy to learn and easy to use. The overarching goal is that these resources will create a wealth of high-quality, real-time data that transforms the practice of environmental science, resource monitoring and watershed protection.

Starting in 2017, Trout Unlimited (TU) began engaging in the EnviroDIY community, eventually building our capacity to provide technical support to our chapters, staff and partners in the use of low-cost real-time stream monitoring technologies. Through this program we seek to provide the necessary technical expertise to remove barriers to the usage of these technologies and resources, enhancing our ability to collect high quality data that aids in the protection and restoration of coldwater fisheries and their watersheds. We continue to work closely with the Stroud Center to build our expertise and guide development of new resources.

This field manual is designed as a resource for groups and individuals adopting and maintaining an EnviroDIY Monitoring Station with a Meter Hydros 21 CTD sensor. Additional resources are in development for other supported sensors (see Appendix A). TU has developed a tech support model that enables us to provide guidance on station siting and permitting. We have the capability to program and partially assemble stations for easy deployment. In certain geographies, we also have the capacity to aid in deployment. In addition, our staff provide ongoing technical support to our chapters, staff and partners that have adopted an EnviroDIY Sensor Station. This manual relies heavily on guidance developed by the Stroud Center, and we thank them for their support.

Monitoring Station Overview

The EnviroDIY Monitoring station supports real time monitoring of water quality and quantity. The station takes measurements at pre-determined intervals (typically every 15 minutes) and uploads those data in real-time to a publicly accessible online database called [Monitor My Watershed \(MMW\)](#). The foundation of the EnviroDIY Sensor Station is the Mayfly Data Logger, an open-source data logger that provides the core functions needed to operate environmental sensors (see Appendix B for logger anatomy diagram). Developed by the Stroud Center, the Mayfly Data Logger provides the scientific community (researchers, citizens and educators) a low-cost, open-source hardware solution for connecting with environmental sensors, recording measurements and relaying data to the internet. The standard station configuration supported by TU measures temperature, depth and conductivity using the [Meter Hydros 21 CTD](#) sensor.

The station consists of a waterproof logger box, which houses the Mayfly Data Logger, the EnviroDIY LTEbee modem, cellular antenna and lithium battery. A SIM card is installed in the EnviroDIY LTEbee modem, which enables data to be transmitted using the 4G LTE cellular network. A microSD card is connected to the logger and all data is recorded to this card as a backup. The station is powered by a lithium battery that is charged by a small solar panel. The logger box is outfitted with waterproof ports through which the solar panel and sensor cables are installed and connected to the data logger. The

waterproof logger box is mounted to a post near the stream. A steel rebar pin is pounded into the streambed and sensors are mounted to a small PVC pipe with a hose clamp, which is secured to the stake with a retaining pin.



Figure 1: EnviroDIY Monitoring Station

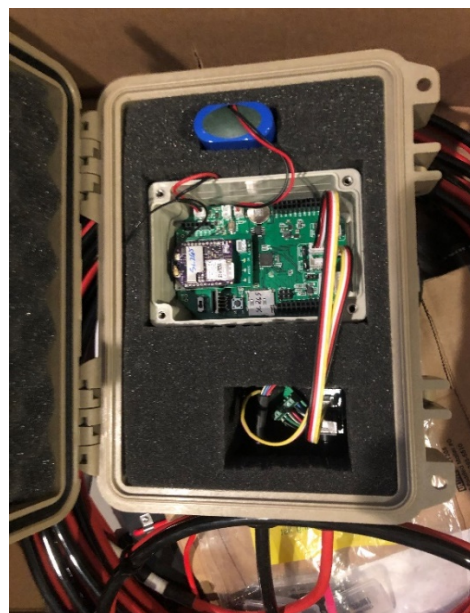


Figure 2: Sensor bundle

Figure 3: Logger Box



Figure 4: [Meter Hydros 21 CTD Sensor](#): Measures conductivity, temperature and depth.

EnviroDIY Station Measured Parameters

Water Depth

Water depth or stage is a relative measurement of the amount of water in a stream or river at a given time. The EnviroDIY Sensor station typically expresses depth in inches or millimeters. The Hydros21 CTD sensor uses a differential pressure transducer to measure the pressure applied by the water column above the sensor. The deeper the water, the more pressure it exerts on the sensor. A direct relationship between pressure and water depth is used to output water depth. The pressure transducer is vented through the cable to atmospheric pressure, which means that depth data does not need to be corrected for fluctuations in barometric pressure.

Water depth measurements can be translated to discharge through development of a [rating curve](#), which requires a series of discharge measurements at varying flows allowing for the development of a relationship between depth and discharge. Discharge, or stream flow, is the volume of water that moves over a designated point over a fixed period of time. It is often expressed as cubic feet per second (ft³/sec).

Access to depth or discharge data allows for more accurate interpretation of water quality data.

Temperature

Water temperature is an important parameter to monitor because it strongly influences the physiology of cold-blooded organisms, the composition of aquatic ecosystems and is often a limiting factor for coldwater-dependent species such as trout and salmon. In general, trout prefer water temperature to not exceed 20-22 degrees C (68-71.6 degrees F). To breathe, trout utilize oxygen that is dissolved in

water. The colder the water the more dissolved oxygen is present. The warmer the water the less dissolved oxygen is present. Temperature is expressed either in degrees Celsius or degrees Fahrenheit.

Most states regulate thermal pollution in rivers based on existing use. Streams that support coldwater species, such as trout and salmon, often have more stringent temperature standards.

For example, Michigan water quality regulations dictate that streams capable of supporting coldwater species should not receive a heat load that would cause either of the following occurrences.

(a) Increase the temperature of the receiving waters at the edge of the mixing zone more than 2 degrees Fahrenheit above the existing natural water temperature.

(b) Increase the temperature of the receiving waters at the edge of the mixing zone to temperatures greater than the following monthly maximum temperatures:

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
38	38	43	54	65	68	68	68	63	56	48	40

Electrical Conductivity

Electrical conductivity is a measurement of the ability of water to pass an electrical current and is expressed in microsiemens per centimeter ($\mu\text{S}/\text{cm}$). The conductivity of water is affected by the presence of dissolved inorganic ions, such as calcium, chloride and magnesium, which enter the water through erosion of rocks and soils, as well as various human impacts such as urban runoff and agriculture. Every stream has a baseline conductivity, which can vary widely from stream to stream, generally ranging from 20 to 1500 $\mu\text{S}/\text{cm}$. Think of conductivity as a tool for a rough assessment of stream health, like a doctor taking your temperature. A rapid increase in conductivity indicates that there is something in the stream that was not there previously, which may signify a water quality problem. Generally, as flow increases, conductivity will decrease since rainwater has a low conductivity and dilutes higher conductivity groundwater. An increase in conductivity corresponding to an increase in streamflow likely indicates that rainwater is picking up some type of ion before entering the stream. A common cause of high conductivity readings is road salt washing into a stream during snowmelt or a rain event.

Most states do not have numeric standards for conductivity. High conductivity has the potential to negatively affect aquatic life, especially benthic macroinvertebrates. Starting at approximately 500 $\mu\text{S}/\text{cm}$, some [macroinvertebrate species](#) are negatively impacted. [Trout growth](#) may be impacted when conductivity exceeds ~2,150 $\mu\text{S}/\text{cm}$. Ions that influence conductivity, such as chloride, are often regulated through state water quality standards. Deicing salts are a common source of chloride, and EPA aquatic life criteria for chronic exposure to chloride is 230 mg/L. Methods for augmenting your conductivity data to understand chloride levels are provided in the Other Resources section at the end of this document.

Station Installation

Parts and Supplies

Equipment and supplies included in EnviroDIY Sensor Station Kit:

- Waterproof logger box with mounting bracket
- Meter Hydros 21 CTD Sensor
- Mayfly Data Logger
- EnviroDIY LTEbee cellular modem
- Cellular antenna
- SIM card
- 2 microSD cards, including one spare
- Lithium-ion battery (shipped separately)
- Adapter cable for connecting CTD sensor to Mayfly
- Coin-cell battery to maintain Mayfly clock setting
- Solar panel with mounting bracket and U-bolt
- Solar panel power cable
- Small hose clamps for mounting logger box to post
- Large hose clamp for attaching sensor to PVC
- Stainless steel retaining pin
- Padlock

Supplies to be purchased by group hosting a station

- $\frac{3}{4}$ " diameter [galvanized](#) or [black iron pipe](#) (one 36" length and one 60" length generally works)
- $\frac{3}{4}$ " [pipe coupler](#)
- $\frac{3}{4}$ " [pipe cap](#)
- $\frac{3}{4}$ " PVC [electrical conduit](#)
- [Steel rebar pin](#) with pre drilled holes (used for sensor mounting, usually 36")
- [Standard rebar](#) for depth pin (usually 3 or 4 ft)
- Tent stakes

Tools necessary for station installation (provided by group hosting station):

- Hammer (preferably heavier hammer such as sledge or [4 pound hammer](#))
- 2x4 wood block
- Wire cutters
- Power drill
- $\frac{3}{16}$ " or $\frac{5}{32}$ " drill bit
- Two pipe wrenches
- [PVC cutter](#) or hacksaw
- $\frac{7}{16}$ " or adjustable wrench for solar panel U-bolt
- Nut driver or flathead screwdriver to tighten hose clamps
- Optional: Gloves to protect hands during deployment

- Optional: [Steel rebar pin](#): used to hammer a pilot hole in the stream bed and on the stream bank and avoid damage to the rebar and pipe (only necessary if streambed is solid and difficult to hammer rebar into).
- Optional: Extension rod for hammering the in-stream rebar pin in deep water where the rebar goes underneath the water (steel rebar pin with PVC pipe attached). Can use 2x4 for this as well if stream bed is relatively soft.



Figure 5: To create extension rod, drill 3 or 4 holes in PVC that line up with pre-drilled holes on a 24 inch steel rebar pin. Cut PVC so that the steel rebar pin extends approximately 3-4 inches above the top of the PVC, and the PVC extends 2 inches below the steel rebar pin (this helps keep the extension rod on another rebar piece when pounding it into the streambed). Attach the pvc using appropriately sized bolts, washers and nylon lock nuts.

Choosing an Installation Location

There are several factors to consider in choosing a location for the sensor station. TU staff can provide support in considering the factors outlined below.

Cellular Signal: Most EnviroDIY sensor stations use the AT&T cellular network to upload data. An easy way to conduct a coarse evaluation of cellular service is to travel to the site and try to open a webpage using a mobile device on an AT&T cellular plan. Generally, if you can load a webpage at the site, there is likely sufficient cellular signal to upload data.

Another useful tool is the FCC 4G LTE [coverage map](#). This map can be useful to gain a general idea of network availability but is not 100% accurate or up to date. In some cases, we have successfully used the Verizon network to send data, but this is not the preferred option.

Cellular signal can be variable and is subject to change during storm events and seasonal changes. Factors such as cloud cover and vegetation cover can affect the cellular signal in some cases. Cellular signal is also subject to change due to issues with the cellular network itself (i.e. temporary cellular network outages).

In areas with weak cell signal the station may consume more power to send data. In this case upgrading to a larger solar panel and batter may be necessary.

If there is not enough cellular signal in the location that needs to be monitored, the EnviroDIY Monitoring Station can be used at that site but data will need to be manually uploaded from CSV files stored on the MicroSD card (see Appendix C for instructions on manual upload of station data).

Sunlight Availability: The EnviroDIY Station uses a solar panel to recharge the lithium-ion polymer battery. It is important for solar panels to be positioned so that adequate sunlight is received throughout the day. Vegetation can be cleared to help with sunlight exposure. However, keep in mind that as the seasons change, vegetation will grow back and can cover the solar panel.

It is also crucial to pay attention to the direction the solar panel is facing. Generally, a solar panel will receive the most sunlight if it is facing south. At times, solar panel orientation can be more important than the size of the panel. If the solar panel is facing in a direction that receives little sunlight, even with a large solar panel, charging may be inadequate. The best position of a solar panel will vary depending on each specific station location. Heavy canopy cover, for instance, may dictate that the solar panel needs to be faced toward breaks in the canopy cover. Positioning a solar panel in a north orientation will rarely occur because it will receive substantially less direct sunlight. As the angle of the sun changes throughout the seasons it may be necessary to adjust the solar panel to obtain optimal sunlight.

The amount of power consumption will vary depending on the number of sensors, strength of cell signal, measurement frequency and other factors. In our experience a station with a CTD sensor taking measurements at 15-minute intervals does not require hours of full sun to operate. We have successfully deployed these stations in wooded areas with the panel oriented southward towards a

break in the canopy. Consistent dappled sunlight throughout the day is often sufficient to power this setup.

Generally, the stations are programmed to stop sending data when battery voltage drops below 3.55V. This enables the station to continue collecting data and recording it to the SD card when there is insufficient power to transmit data. If your station consistently drops below this threshold, resulting in data gaps on MMW, you may need to consider reorienting your solar panel, clearing vegetation or upgrading your battery and/or solar panel.

River and Stream Morphological Features: Station placement should take into consideration stormwater flows and whether these flows will expose the sensor to scouring forces and movement of bedload, or is in the path of debris. Often, to avoid storm flow damage, it is necessary to position sensors on the inside of stream bends or behind obstructions (e.g., boulders, trees, abutments) that provide protection from extreme stormwater flows. While protecting the sensors from high flows is important, you should avoid backwater areas and eddies. A depth of at least one foot, and no more than three feet is needed. You want to ensure that the sensor will stay submerged year-round, but also that you can reach the sensor bundle for maintenance during most flow conditions.

Ice is another consideration. It is generally fine for ice to encase the sensor cable. But if the sensor becomes encased in ice, damage is likely to occur. The sensor must be placed at a sufficient depth to avoid ice. If this is not possible, the sensor may need to be removed from the stream during the winter or another location should be identified.

Avoid deploying immediately downstream of tributaries or point sources that may not represent the mainstem of the channel, as full lateral mixing may require a long distance of stream channel (Figure 6). Turbulent streamflow (riffles and rapids) should be avoided, as turbulence can create problems in monitoring some field parameters, as well as contribute to sensor damage.



Figure 6: A confluence of two streams showing lack of mixing

Generally, it is best to place sensors in the thalweg, or deepest channel in a stream. But this is often not practical for the EnviroDIY Sensor Station, except in very small streams. On larger streams and rivers, it is

often necessary to place the sensors near the streambank to ensure protection during high flows and to facilitate easier access to the sensor. If deploying a sensor near the stream bank it is a good practice to conduct a cross-section survey of field parameters to ensure that conditions near the bank are representative of mainstem conditions. For example, installing sensors adjacent to a groundwater seep would cause the station to measure temperature conditions that are not representative of the ambient stream conditions. Cross sections are completed by taking measurements (temperature, conductivity, etc) at regular intervals across the width of the stream. Depending on the width of the stream 8-10 measurements should suffice. Additional cross-section measurements should be made after equipment installation to ensure that the monitoring station installation is representative of the stream during all seasons and hydrographic flow conditions.

If there are plans to develop a depth/discharge rating curve at the site, there are additional considerations for site selection. The stream should be confined to one channel, avoiding braided sections or areas where the stream splits around an island. It is also important to choose a location that is less susceptible to scour and fill, and where stream banks are stable. Generally, the more stable the streambed and stream banks, the better for rating curve development. It is also important that it is safe to wade across the stream at the site, which is necessary for conducting discharge measurements.

Overall, a monitoring site should be safe and accessible, meet minimum depth requirements of the equipment and be representative of the entire stream. It may be necessary to reconnoiter the site under several flow conditions before a determination is made.

Other Factors: When positioning logger stations on the stream bank, the stability and erosion potential of banks should be considered. Abstain from installing a station near areas on the stream bank that seem to be undercut. If a station is installed on an erosional surface, it is likely that the station will not survive long term. The galvanized pipe that is used to mount the data logger box should be at a sufficient depth to withstand flood conditions without becoming dislodged: marshy areas with soft sediment will require at least 4' of pipe installed into the ground, whereas rockier locations may only need 30-36" installed into the ground. If a location has sediment that is very sandy or has a lot of gravel, be aware that your pipe underground needs to be installed at a depth where the pipe will not rotate or spin loosely in the hole. If you try to spin or wiggle the pipe, it should hardly move.

The composition of the stream bed can determine what station parts are able to be used, particularly in regard to the in-stream sensor bundle. For example, if the bed composition is extremely rocky, or near bedrock, a shorter 2' rebar will need to be used. If the stream bed is extremely soft (e.g., loose sand or mud) it may be necessary to use a longer rebar or other stake to ensure the sensors are stable within the channel. It is best to avoid installing the sensor in an area with deep loose silt.

For ease of access in conducting maintenance, the sensor bundle should be placed at a location out of the main flow path, near the stream bank. Sensor wires should never run across the stream bottom from one bank to another because this greatly increases the probability of damage to the sensor in high flow conditions. Always mount the sensor bundle near the same bank where the logger box is mounted. The sensor cables are about ten meters in length; however extension cables can be purchased if the location of the data logger box needs to be farther from the sensor location. Data logger boxes should be positioned well above any expected flood levels.

The stations are susceptible to vandalism, and the security of the station should be considered in choosing a site. It is often preferable to place stations on private land, to limit the likelihood of vandalism. When placing the station on public lands it may be prudent to place the station in an out-of-the way location, where foot traffic is limited. In other cases, it may make sense to place the station out in the open. In either situation, installing signage next to the sensor is a good idea. The sign should provide information on the host organization, where to access the data and contact info.

Installation Steps

Step by step videos are available [here](#).

Drill retaining pin holes in PVC

1. Lay your PVC next to the rebar mounting stake, with tops flush. Mark the location on the PVC that lines up with the topmost pre-drilled hole in the rebar (Figure 7).
2. Careful to position the drill bit perpendicular to the PVC, drill all the way through creating two holes on either side of the PVC.
 - a. Slide the PVC over the rebar mounting stake and slide the retaining pin through the holes to ensure they are lined up appropriately. If the retaining pin will not slide through, the holes can be enlarged slightly. If enlarging the holes doesn't work, try drilling a new set of retaining pin holes.



Figure 7: Lining up retaining pin holes

Set mounting stake

3. Hammer the steel rebar test post into the stream bed to find a secure stable spot.
4. Set the mounting stake (solid steel rebar pin with a pointed end that will be the attachment point for the sensor bundle).
 - a. This rebar is driven into the stream bottom using a hammer and a wood block to prevent damage to the top of the stake.

- b. The length of rebar should be driven deep enough into the streambed to ensure that the sensor bundle and mounting stake will not move during flood events.
- c. The rebar should be hammered so that the top of the rebar is flush with (or slightly below) the water surface.

Prepare to install the logger box

5. Find a location on the stream bank for the station post/box with good sun exposure.
 - a. Clear the area on the bank where the data logger box will be positioned by removing vegetation that may block sunlight to solar panels or that may cause problems during floods.
 - b. Alternatively, if vandalism is a concern, leave some vegetation around the station to help camouflage it.
6. Two sections of $\frac{3}{4}$ " diameter threaded black iron or galvanized pipe are used to create the data logger mounting pole: a shorter length (typically 36" long) that will be hammered into the ground and a longer length (typically 60" long) on which the logger box will be mounted.
7. Pound in a stake to create a pilot hole, then attach a $\frac{3}{4}$ " coupler to the shorter pipe and hammer the pipe into the ground (place a 2x4 wood block on top of the coupler to prevent damage, see Figure 8).
 - a. Stop hammering the shorter pipe into the ground with a few inches between the ground surface and the coupler.
8. Tighten the coupler onto the short pipe using pipe wrenches.
9. Twist the larger pipe onto the coupler and tighten again using the pipe wrenches (Figure 9).

Note that pipe lengths vary based on the station location conditions. For example, if the ground is soft, a longer section of pipe may need to be pounded into the ground to provide sufficient stability.



Figure 8: Hammer shorter pipe into ground.



Figure 9: Attach longer pipe

Attach logger box to pole

10. Attach the logger box to the pole by 1) sliding two stainless steel hose clamps (7/8" to 1 ½" size) through the gap between the back of the logger box and the mending plate, 2) tighten the hose clamps around the pole (Figure 10).
 - a. To make it easier to secure, place the nuts of both hose clamps on the same side.
11. Determine how high the data logger box should be on the pole by considering who will need to access this station: place the logger box approximately chest to eye level for the volunteer who will be maintaining the station. Allow a sufficient length of post above the logger box to mount the solar panel.
12. Also consider stormflows, noting high water marks in the area or debris that indicate how high the water gets during high flow events. Place the logger box above the high-water mark to prevent it from being submerged.
13. Tighten the hose clamps.

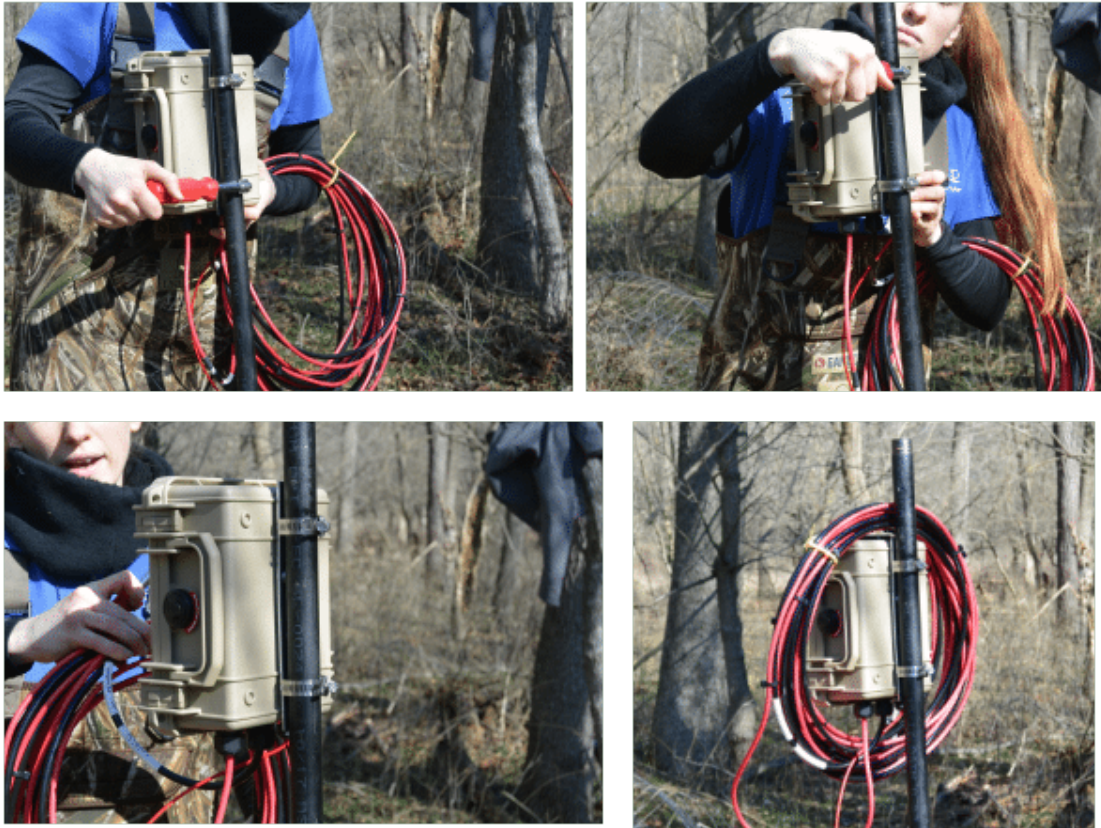


Figure 10: Attach logger box to pole with small hose clamps.

Prepare the sensor bundle

14. Cut the $\frac{3}{4}$ " PVC pipe to the appropriate length (Figure 11).
 - a. Place the PVC over the mounting stake that has been pounded into the streambed, with the drilled retaining pin holes at the bottom.
 - b. Mark the PVC where it lines up with the top of the rebar mounting stake.
 - c. NOTE: always cut at height of rebar, not the stream surface line.
 - d. Do the final cut of PVC using the PVC cutter or a hacksaw and fit on rebar to check and make sure the cut lines up properly. If the cut was done properly the top of the PVC pipe will be flush with the top of the rebar.



Figure 11: Cut PVC to appropriate length

Attach sensor bundle to PVC

15. Unwind the sensor cables at the data logger box.
16. Attach sensors to PVC using the larger hose clamp and the nut driver or screwdriver (Figure 12).

Things to note:

- a. The sensors need to be a certain height from bottom (about 3" if possible); this is site specific and depends on the amount of sediment and rocks on the stream bottom.
- b. The four metal screws within the CTD sensor should be facing upstream.
- c. The hose clamp should be tightened above center/middle of CTD sensor to avoid damage to the pressure transducer.
- d. Tighten to the extent that sensor doesn't move up/down, but not tight enough to cause damage to the sensor.



Figure 12: Attach sensor to PVC with large hose clamp.

Attach the sensor bundle to rebar

17. Place sensor cables from sensor box (on land) to the rebar mounted in stream.
 - a. Lay out all cables first, then bundle what you don't need at sensor box.
 - b. Wrap cables under roots along the bank that are stable.
 - c. Do not attach to vines or loose materials that will break during storm events.
18. Secure the sensor bundle using the metal retaining pin (Figure 13).
 - a. Line up PVC retaining pin holes and top-most pre-drilled holes on the rebar mounting stake.

- b. Insert pin from upstream side so clamping is on downstream side (to prevent debris from building up).

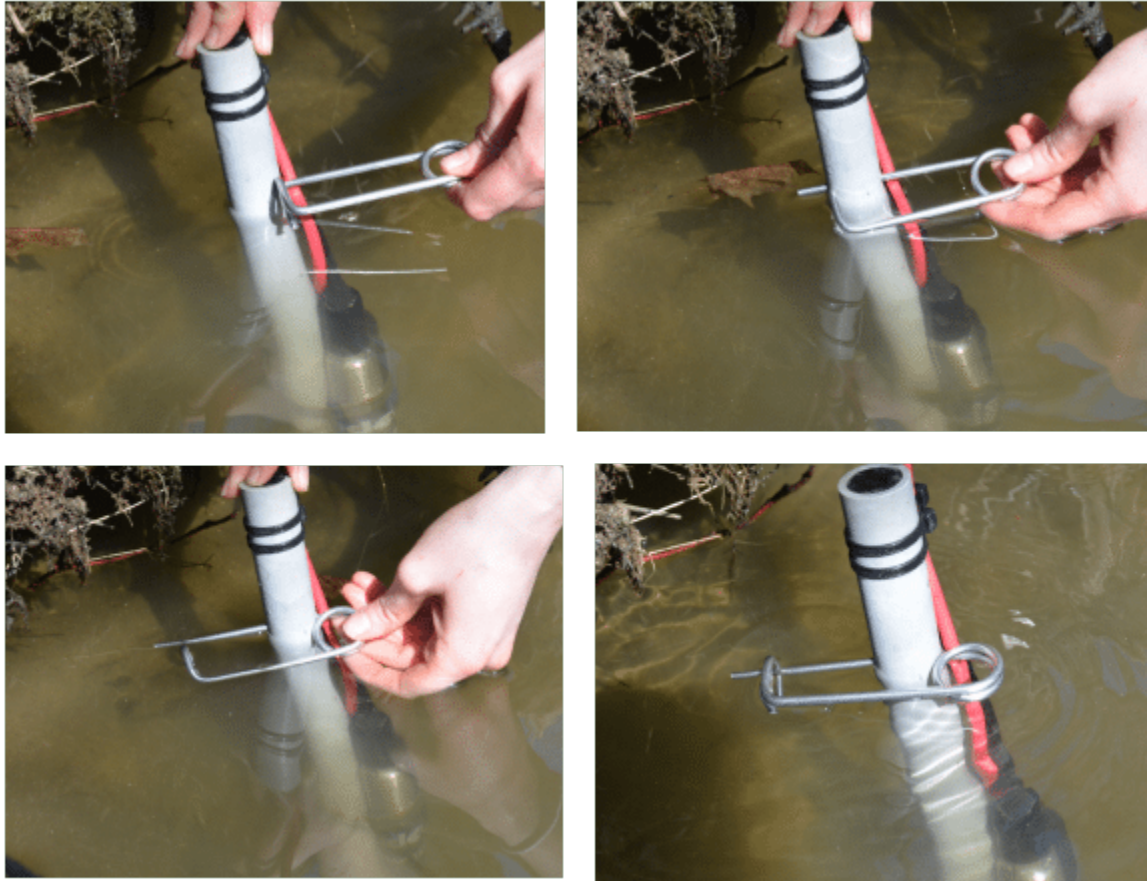


Figure 13: Attaching PVC to steel rebar pin with retaining pin.

- 19. Work from the sensor bundle back to the data logger box when securing the cables using tent stakes and zip ties.
 - a. Use zip ties to attach sensor cables to the top of the PVC so cables are not in the way of the retaining pin holes.
- 20. Secure the sensor cables along bank keeping these things in mind:
 - a. Use zip ties, tent stakes, hammer, and wire clippers.
 - b. Use stable roots.
 - c. Leave a little give between stakes (stabilization spots).
 - d. Two zip ties might be needed if a root is wide.
- 21. Zip tie tips:
 - a. Don't pull too tight in the cold as they are brittle and will break.
 - b. Use black zip ties with UV protection for outdoor use, not white zip ties (these will break more quickly if being used outdoors).
- 22. In some cases, the sensor cable can be buried in pvc conduit to the logger box for additional protection.

Attach solar panel to post

23. Solar panel orientation should be in a southerly direction, oriented towards breaks in the canopy if needed. Keep in mind obstructions to sunlight such as leaves, and account for this when choosing a direction for your solar panel.
24. Adjust as necessary for height.
25. Attach the solar panel mounting plate with U-bolt and tighten by hand first, then with wrench (7/16"); don't over tighten, as the plate is aluminum and may bend (Figure 14).
26. Connect solar panel wire: there are two notches on side of the panel plug. Push wire from logger box all the way past notches (this makes it waterproof). Once connected, an orange light will appear on the top left of the Mayfly Data Logger inside of the logger box.
 - a. This display will show whether or not the lithium-ion polymer battery is being charged.
 - b. If the LED light on the Mayfly Data Logger does not come on, this means that either the solar panel wire is not connected, or that the battery is fully charged.
27. Secure solar panel wire with zip ties.
28. Secure all wires and trim with cutters (making a horizontal cut as this makes the cut less sharp).

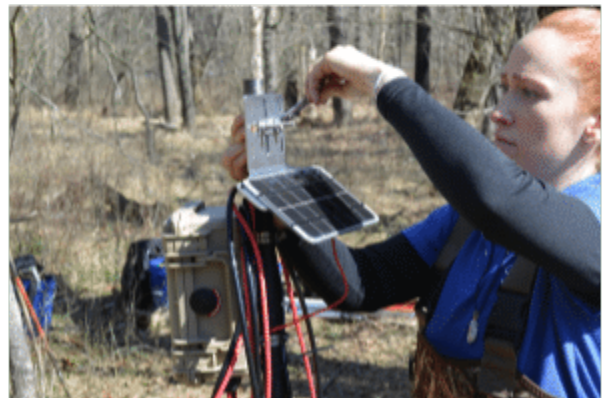


Figure 14: Attaching solar panel to post.

Attach sensor wires to the post.

29. Bring sensor cables to the logger box and loop them neatly around the logger box post.

30. Pass auxiliary plug end of sensor cable through the waterproof port in the logger box.
31. Plug the sensor plug into the grove port adapter (grove port adapter should be plugged into port D4-7 in the Mayfly logger v1.0). Ensure that the auxiliary plug is plugged in all the way and flush with the adapter cable port (there should be no silver adapter plug visible).
32. Hand tighten the nut on the waterproof port to seal around cable.
33. Secure the sensor cables with zip ties: do not pinch or crimp the CTD cable (particularly the white vented area of the cable) because this could damage the vented tube inside the cable and affect pressure (depth) measurements.
34. Trim zip ties on the pole, but do not trim zip ties along wire length on the ground so you can find the wire if needed at a later time.

Make final adjustments

35. At the top of the monitoring station post, add a ¾" threaded pipe cap to keep out critters such as bees, ants, or spiders.
36. Turn on monitoring station and check for functionality by ensuring the LTE modem lights up and checking MMW for data upload.
37. Set combination code for the padlock following the instructions included with the lock.
38. Place lock on box.
39. A laminated sign, sticker, or business card should be attached to the logger box. Information on this signage should include at minimum contact information of the person/organization managing the station. Additional information may include descriptions of station function, monitoring goals, project descriptions and educational intentions.

Install depth reference rebar: This section is not included in Stroud Video

40. To provide a reference measurement for quality control of depth measurements, a second rebar is pounded into the streambed near the sensors. Rebar length will depend upon streambed composition, but should be long enough to be very secure when pounded into the stream. A three or four foot long rebar should work. The rebar should be painted orange at the top with spray paint to make it more visible. This should be done before travelling to the site or immediately upon arrival to allow time for the paint to dry.
41. Pound the rebar pin into the stream bottom near the sensor, deep enough so that it will be underwater during baseflow and is secure and stable in the stream bottom. Generally, leave approximately 5 or 6 inches of rebar above the stream bottom.
42. By measuring the distance from the water surface to the top of the rebar pin and subtracting the depth measured by the sensor at the same time, an offset can be calculated. This offset should remain consistent. This will be covered further in the QC section of this manual.

Monitoring Station Management

Management of the EnviroDIY Monitoring Station includes quality control checks, sensor cleaning, data tracking and other tasks associated with keeping the station functioning properly. It is extremely important to maintain the EnviroDIY station to ensure ongoing collection of quality data. In general, station maintenance includes the following tasks:

- Monthly sensor cleaning (cleaning frequency may vary by stream and should be informed by station data)
- Quarterly quality control checks
- Regular tracking of sensor station data on MMW
- General as-needed station maintenance

Sensor Cleaning

Most of the time sensors can be cleaned without removing the sensor bundle from the stream. Depending on the stream conditions, weather and any other environmental influences or unforeseen technical problems with the stations, sensor cleaning frequency may range from weekly to monthly.

The Meter Hydros 21 CTD sensor cleaning involves scrubbing the semi-enclosed parts of the sensor (four point Wenner array shown in Figure 15) with a scrub brush to remove any accumulated dirt and debris. Generally, monthly cleanings are sufficient for the CTD sensor.

To clean the sensors in-stream

1. Before cleaning the station take care to ensure that cleaning does not take place while the sensor is recording a measurement. This can either be accomplished by turning the station off or cleaning the sensor during the interval between measurements.
2. Clear all accumulated debris on the stream bottom away from the sensors using hands and feet or a tool if necessary.
3. Remove all large pieces of material (leaves, sticks) from the sensor bundle by hand or with the long bristles of the sensor brush.
4. Use the longer bristles of the sensor brush to gently clean the side slots on the CTD sensor.
5. If there are any sticks or hard objects wedged in the slot make sure to remove them carefully so as to not damage the pressure transducer (the white disc in the CTD sensor).
6. Use the long bristles to clean the four screw heads inside the side slot (these are the points at which conductivity is measured).

Note: Trapper gloves (such as [these](#)) are a recommended purchase for winter station maintenance.



Figure 15: Four point Wenner array

Sensor deep clean

It is recommended that the sensors bundle is removed from the mounting stake once a year for a deep clean.

1. When removing the sensor bundle, it is important to take care to ensure that it is replaced at the same level and orientation to ensure consistent data. Take note of the position of the PVC conduit with regard to the mounting stake. Also note the position and orientation of the retaining pin.
2. Turn the station off before removing the sensor bundle.
3. If necessary, remove stakes and zip ties to free the sensor cable so it can be brought to the stream bank.
4. Remove the retaining pin.
5. Slide the sensor bundle off mounting stake. If the mounting stakes moves at all during this process, be sure to note this in your field notebook.
6. Run water through the side windows across the pressure transducer to remove debris. A plastic pitcher or bucket can be used for this.
7. If running water through the windows does not remove debris, soak the sensor in a water/dish soap mixture for an hour, then rinse thoroughly.
8. Clean the four small screws, where conductivity is measured, carefully with a cotton swab.
9. Remount the sensor bundle, making sure the orientation is the same as it was before removing it by sliding the PVC conduit over the mounting stake, lining up the PVC conduit holes with the mounting stake holes at the same vertical level as before.
10. Slide the retaining pin through the upstream hole and out the downstream hole and lock the pin.
11. A cross check for depth should be conducted after removing the sensor bundle to ensure the vertical level of the sensor hasn't changed (depth cross checks discussed in the next section).

Quality Control Checks

On a quarterly basis, quality control checks should be conducted for each station. Sensors can foul, malfunction or get damaged, therefore quality control cross-checks are highly recommended using a secondary measurement device. All quality control measurements should be recorded in a field notebook, then uploaded to our online database at www.citsci.org, or using the [CitSci.org mobile app](#). See Appendix D for instructions on entering data online.

A certain level of error is inherent in monitoring station sensors and in all handheld sensors, so there is no defined limit specified for what is acceptable in terms of variability in these measurements. In the sections below, some guidance is provided for determining whether variability between QC data and sensor station data warrant troubleshooting. If you believe your QC data indicates a problem with your sensor, contact Jake Lemon at jlemon@tu.org to discuss.

Temperature QC

It is recommended that you use a thermometer calibrated to ISO 17025 traceability standards to conduct temperature cross checks, such as [this](#). Measure temperature using the same temperature scale your station reports water temperature in (typically Fahrenheit). Temperature should be measured within a foot of the sensor location. Place the probe in the stream and wait for the temperature measurement to stabilize, then record your measurement. Generally, if your handheld sensor measurement deviates more than 2 or 3 degrees Fahrenheit from the sensor station, you should consider troubleshooting potential sensor issues.

Conductivity QC

Conductivity cross-checks should be conducted using a calibrated handheld sensor, such as [this](#). The sensor should be calibrated following methods in the sensor manual before each quarterly QC check. Place the sensor in the stream within a foot of the sensor bundle, ensuring that you are completely submerging the conductivity probes. Wait for the measurement to stabilize, then record your measurement. Generally, if your handheld sensor measurements deviates more than 30-40 us/cm from your sensor station, you should consider troubleshooting potential sensor issues.

Depth QC

When your sensor station was deployed, a rebar pin was driven into the streambed next to the sensor bundle to be used in cross-checking depth data. To check your depth readings, measure the distance from the top of your rebar pin to the water surface. Be sure to measure in the same units your sensor station is reporting depth in (inches or millimeters usually). Note that inch measurements reported by the sensor are reported in decimals rather than fractions. Ideally, you should use a yard stick that measures in decimal inches. Alternatively, you can convert fraction inches to decimal inches, such as in the example below.

Depth QC Fraction measurement: 16 5/8"

5 divided by 8 = 0.625

Depth QC Decimal measurement: 16.625

Subtract the QC depth measurement from your station measurement, such as in the example below, to calculate an offset.

Sensor station depth: 10.2

QC Depth (16.625) – Sensor Station depth (10.2) = Offset (6.425)

This offset represents the difference between water depth as measured using the rebar pin, and as measured by the CTD sensor. This offset should remain consistent over time and at different water depths. Any substantial changes to this offset indicate either a problem with the CTD sensor or the stream bottom rebar pin. Also, if the CTD sensor is removed from the stream, this offset can be used to ensure that, when the CTD sensor is re-installed, it can be positioned at the exact same depth at which it was previously positioned. Consistency in depth readings (i.e. positioning the CTD sensor at a consistent depth) is critical for developing rating curves and conducting analysis of continuous depth data.

Tracking Sensor Station Data

To ensure reliability of monitoring station data, data trends and patterns should be regularly evaluated. Graphical displays of data and assessment of the data in the context of the specific site conditions and ecological expectations should be used as a quality control measure to ensure data reliability. Issues and problems to look for in data-quality assessments are extensive but there are specific common issues that can be considered when troubleshooting for problems in sensor data (some common problems are discussed later in this manual). If monitoring station data appear suspicious (outside of normal range for the site, erratic, etc.) cross-checks with other calibrated sensors should be done immediately. If monitoring station data appear normal, cross-checks with handheld sensors should be done quarterly as a general quality control method.

Other Station Maintenance

Logger Box and Solar Panel

Similar to the sensors, the logger box, solar panel, and associated components will require regular maintenance. All debris and vegetation should be cleared from around and above the logger station.

The logger box is waterproof but it should be opened periodically to confirm that no moisture has entered and that the Mayfly Data Logger and all other internal components are intact. Vegetation should be cut back from around the logger box and solar panel. Although the logger box is fully sealed from the external environment, vegetation can get in the way when opening the box and can possibly introduce water, insects, and debris. Anytime the logger box is opened it is important when closing the box to ensure that there is no grass, leaves, stems, or other debris breaching the seal: this debris will allow moisture into the box and could damage the electronics.

Vegetation covering the solar panel can reduce solar exposure as can debris and dust accumulation on the solar panel. Vegetation should be cut back on a regular basis from beneath and around the logger box and solar panel. Clean dust and debris from solar panel with your hand or with a soft cloth. The canopy above the solar panel should be kept open enough to ensure adequate exposure to sunlight. Snow may need to be cleared off the solar panel after a heavy snowfall.

Freezing Risk

The issue of highest concern during winter is damage to the pressure transducer in the Hydros 21 CTD sensor. The pressure transducer, as the name implies, is sensitive to pressure changes, so when water expands during freezing the pressure of the ice directly against the pressure transducer can damage it. If freezing does occur around the CTD sensors all data will be inaccurate during this time period. Depth data will be suspect and should be closely checked after the ice melts to determine if the sensor was damaged. Temperature and conductivity data should return to normal but should also be checked to ensure accuracy after the ice thaws, as these can be affected if the pressure transducer is damaged.

The shallower the water in which sensors are positioned, the higher the risk of freezing. Monitoring air and water temperatures during the winter can be important, especially in cases where sensors are located within the part of the water column where freezing may occur. Freezing risk is generally highest in small streams where there are no deep locations available for sensor placement but freezing may also be a risk for deeper sensors during severe and extended low air temperatures. Ice that forms at a depth

above the sensors is not a high risk to sensor integrity, but this can make it difficult to access sensors. If the ice has to be broken with a hammer or chisel there is risk of damage via direct contact of the hammer/chisel with the sensors and/or sensor cables. There is also a risk of damage to sensors through shifting pieces of ice as they are broken and through possible damage from the shock of the hammer or chisel. If freezing of the water surface is an issue and cleaning sensors during this time period is important it is recommended that ice layers be removed on a frequent enough basis so as to not require a hammer or chisel for breaking the ice (i.e., remove ice when it can be broken by hand). Clearing ice at this frequency will ensure that the sensors are accessible for cleaning and ensuring accurate data.

Power Management

The target voltage level for the battery is 3.7 V or higher. Below this level the station may lose functionality and data may stop transmitting to the web data portals. The typical battery voltage pattern is for the battery to charge during the day and lose power during the night (Figure 16). In certain scenarios where sunlight is restricted or diminished due to canopy coverage, cloudy days, or seasonality, battery level may decline over multiple days due to inadequate solar exposure and incomplete charging. This gradual decline may also happen when cell coverage is intermittent, in which case the Mayfly Data Logger may make repeated unsuccessful attempts to send data to the website using extra power each time.

In some cases, solar charging may vary throughout the year with seasonal canopy cover changes as well as other canopy cover changes (e.g., fallen trees, growth of vegetation). Reposition the solar panel to receive better sun exposure as needed. In extreme cases DIY methods can be used to place solar panels and/or the logger box itself in locations that will provide adequate solar coverage (e.g., placing solar panel high above vegetation and separate from the logger box).

Basic rule of thumb to follow when monitoring your online battery voltage:

- 4.0V or above: fully charged battery
- 3.7V-3.9V: sufficiently charged battery
- 3.7V is the nominal voltage (Nominal voltage is the default, resting voltage of a battery pack). The middle ground between fully charged and the low voltage cutoff.
- 3.55V-3.7V: start to keep an eye on the battery pattern
- 3.55V or below: if it stays at or below 3.55V for an extended period of time you may want to replace your battery or upgrade your solar panel. If you see that your station has dropped offline and your battery is below 3.55V, you will need to troubleshoot.

In cases where solar charging is not adequate for keeping the battery above 3.7 V it may be necessary to assist in powering the stations with a second fully charged replacement battery. If this is the case for your station, contact TU support staff for assistance.

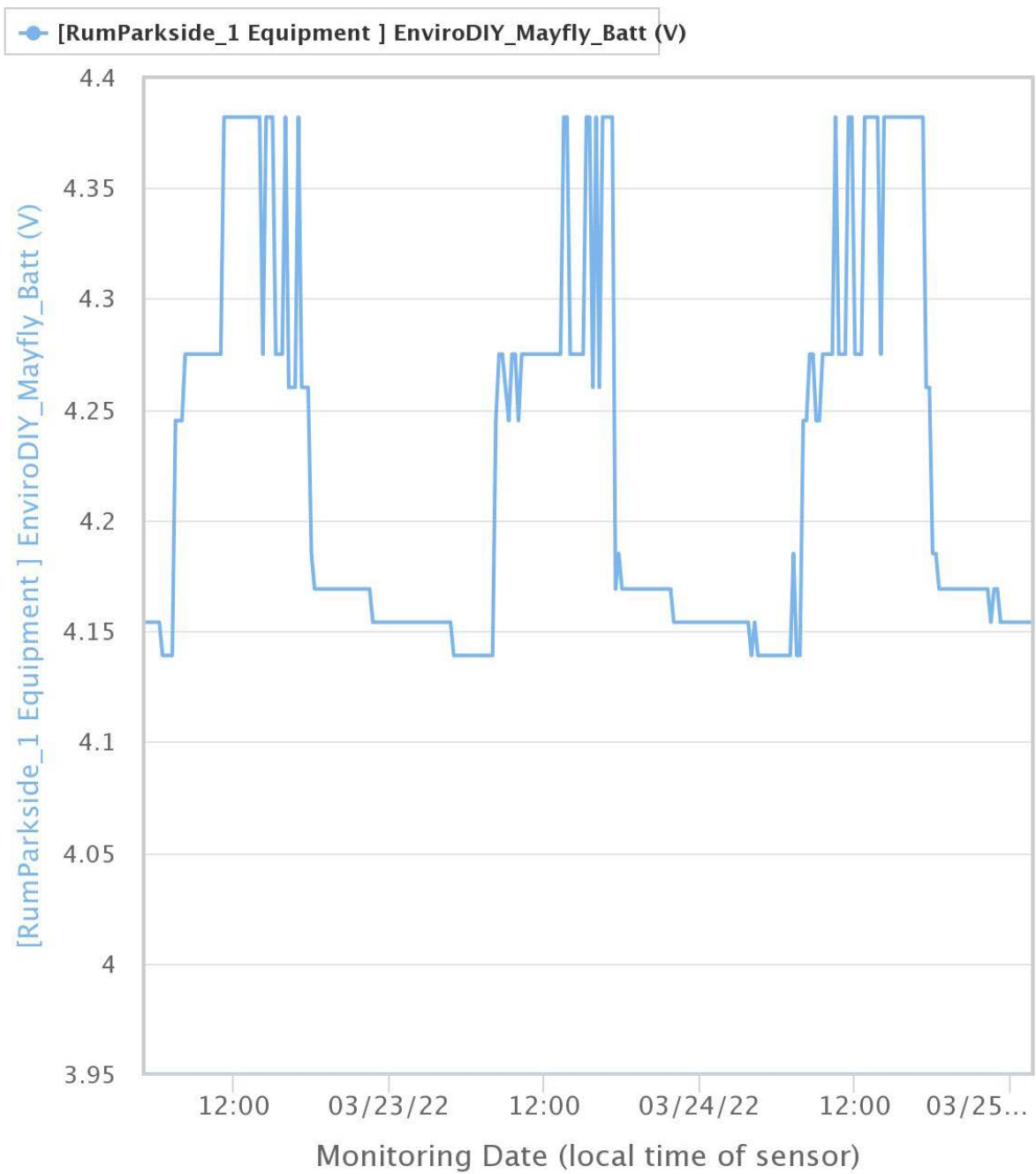


Figure 16: Battery charging pattern

Monitor My Watershed

[Monitor My Watershed](#) (MMW) is a web data portal to which all data from EnviroDIY Sensor Stations with cellular coverage are transmitted. TU staff will set up your site on MMW prior to deployment of your monitoring station. For details on how to view, share, download and upload data on MMW, please refer to Appendix C: Stroud Monitor My Watershed Sensor Data Manual.

To upload data to MMW you will need to activate a cellular data plan for your site, which will be paid for by the owner of the station. EnviroDIY Sensor Station cellular plans are purchased through [Hologram](#). A Hologram SIM card will be included with your station kit. Data plan costs will vary depending upon the frequency in which you upload data to the site. If your station uploads data at 15 minute intervals, a data plan will cost roughly \$6-8 per month per station. You should activate your cellular plan prior to station installation.

To do so, sign up for an account at <http://hologram.io>. Once you have an account, select “Billing” to add a credit card. You will need to add funds to the account prior to billing, you will not receive a regular bill from Hologram based on your data usage. It is recommended that you set up “auto-refill” so that data upload isn’t interrupted due to a lack of funds in the account. Select “Devices” then “Activate SIMs” to activate your SIM. Each SIM will have an 18-22 digit code. Enter that code into the dialog box and click “Continue”. Select the “Standard” tab. Click the “Coverage Area” drop-down box and select “Global”. Choose the “Pay as you go” option and click “Continue”. Skip the “set data usage limits” step. Assign a custom name that will indicate which site the SIM is connected to. You may assign tags to devices if you wish. Choose your payment option and select “Continue”. Review your selections then click “Pay and Activate”. After a short processing time your SIM will be active. Install the SIM into the cellular module and your station is ready to upload data.

Data Patterns and Troubleshooting

No Data or Intermittent Data on MMW

It is important to regularly check MMW to ensure station data is being uploaded. If the station is not uploading data to MMW it will be necessary to troubleshoot the potential issue. Tips for troubleshooting are listed below.

- Check battery voltage during the last data communication on MMW. If voltage is 3.7 or lower, the battery could be the issue. The station will stop sending data at 3.55V.
- At the station, check to ensure that the cell antenna and cell module are fully plugged in.
- Check to ensure that SIM card is installed correctly.
- Check Hologram account to ensure SIM is active and you have an adequate balance on your account for data charges.
- Power cycle the station by switching the power switch off then on again (power switch is on the bottom left of the board). Wait to see if the station uploads data to MMW at the next measurement interval.
- Pull the microSD card and view the data on a computer. If data is being logged to the SD card, but is not being transmitted to MMW, it is likely an issue with cellular signal, the cellular module or the cellular antenna.

- Conduct a rough check of cellular connectivity by loading a webpage on a smartphone at the site (only applicable if using the same cellular provider as the station, usually AT&T). If a webpage will not load at the location, then cellular signal may have deteriorated at the site, and could be the culprit.
- Restart the station and note the light sequence on the cellular modem. The light sequence should match the descriptions below. If they do not, it may indicate an issue with the cellular modem that requires replacement.
 EnviroDIY LTEbee Modem: Solid red light and flashing blue light on modem on startup. Should switch off after a minute or less. Will turn back on during next measurement interval.
 Digi LTEbee Modem: Blue and White light (Assoc and On) lights up on startup. May flash intermittently. Orange RSSI light will come on after indicating connection with cellular network. Lights will shut off after a minute or less (if lights remain on for longer it may indicate difficulty in connecting with the cellular network). During the next measurement interval white light (On) will be solid, blue (Assoc) light will be solid then start flashing. Later the orange (assoc) light will come on. Lights should turn off within a minute or so.

Dropping Battery Voltage

- Clear solar panel of snow, dust or debris.
- Check solar panel cable connections (connection to the Mayfly logger and Auxiliary connection outside of logger box).
- Trim overhanging vegetation.
- Re-orient solar panel to improve solar exposure.
- Consider larger panel or battery.

Erroneous Data

- Restart station
- Clean sensors
- Inspect sensor and cable for damage
- Consider replacing sensor

The following series of graphs (Figures 17-23) provide examples of ecological data patterns, data patterns that may indicate pollution incidents and data patterns that may indicate sensor malfunction.

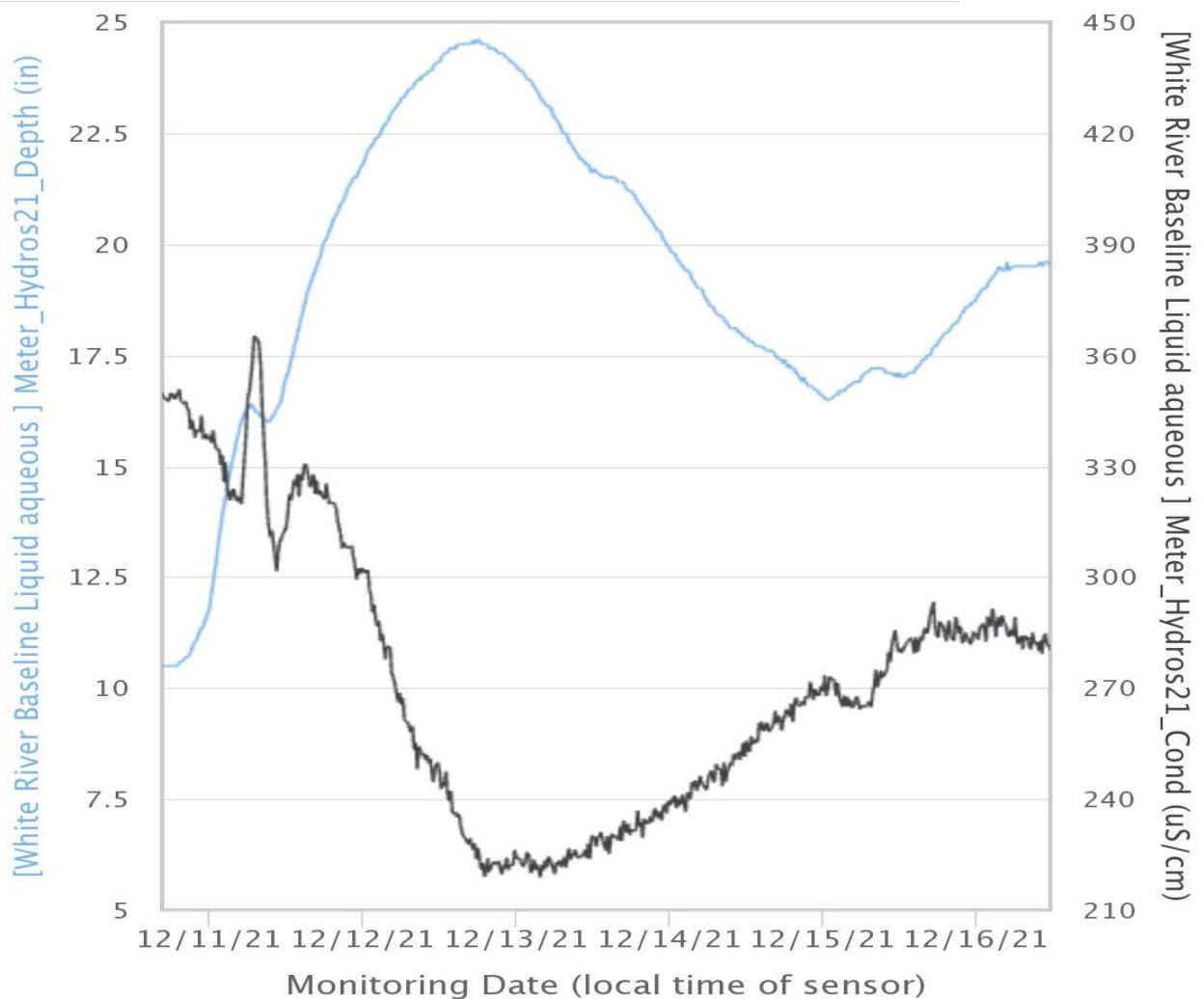


Figure 17: Typical conductivity and stream depth relationship. Typically, conductivity (black) decreases as water depth (blue) increases. When rain or snowmelt events occur, low conductivity rainwater dilutes higher conductivity groundwater/baseflow. This results in an inverse relationship between conductivity and depth.

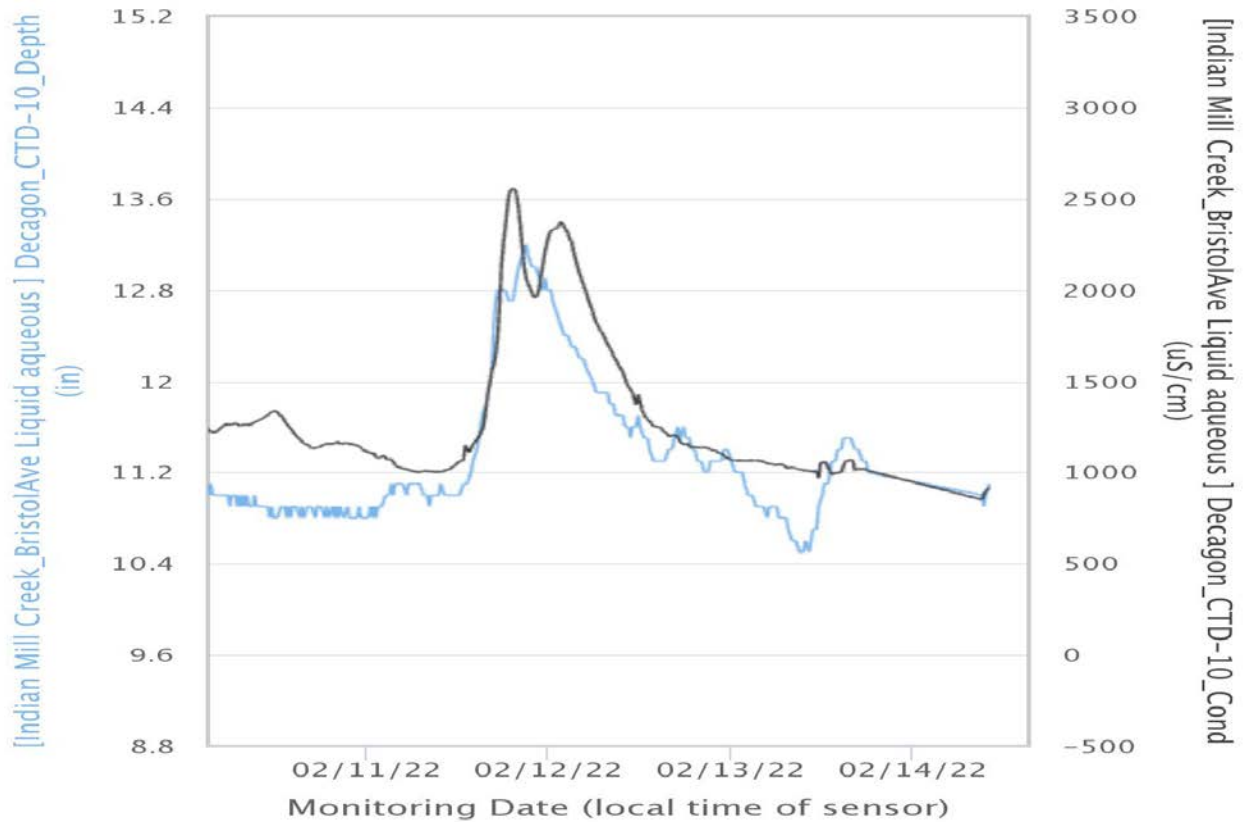


Figure 18: Conductivity/water depth relationship indicative of contamination. Spikes in conductivity (black) corresponding to an increase in depth (blue) indicates potential input of contamination into the stream. Road salt runoff in this case.

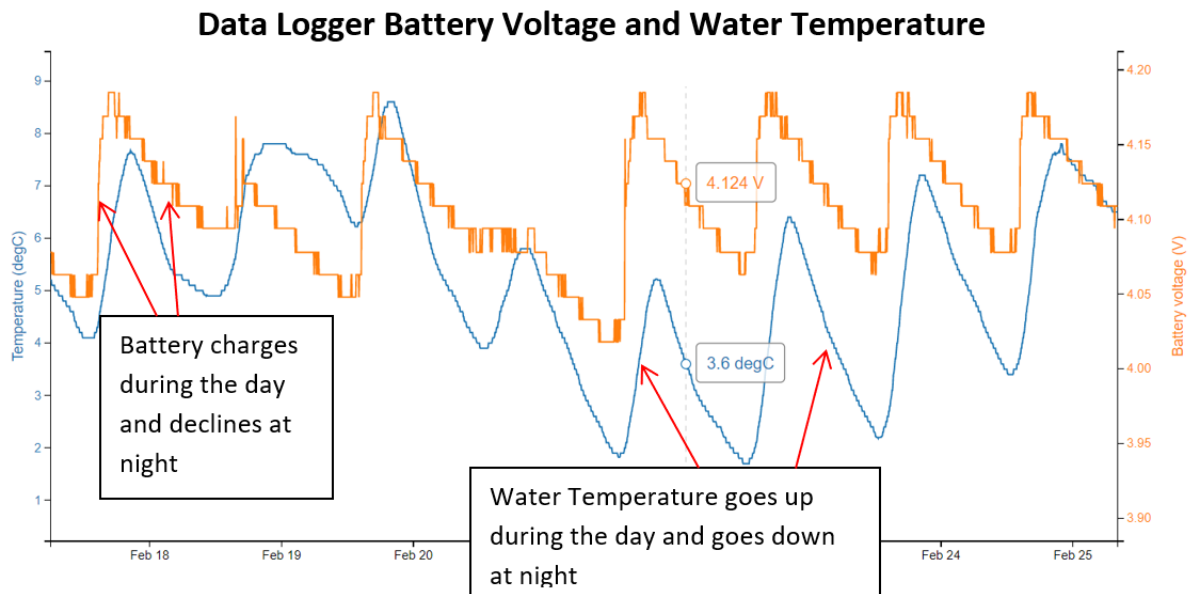


Figure 19: Typical water temperature and battery charging trends

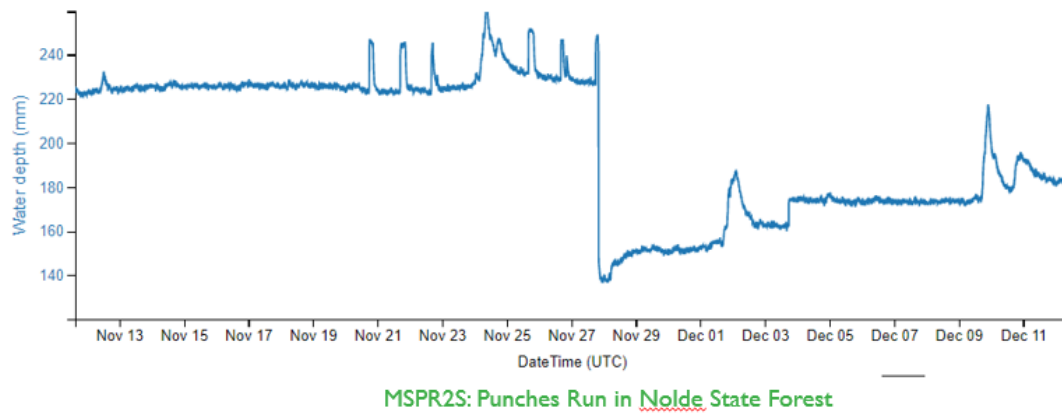


Figure 20: Example data issue. Sensor bundle removed for cleaning but replaced at a lower depth creating inconsistent data.

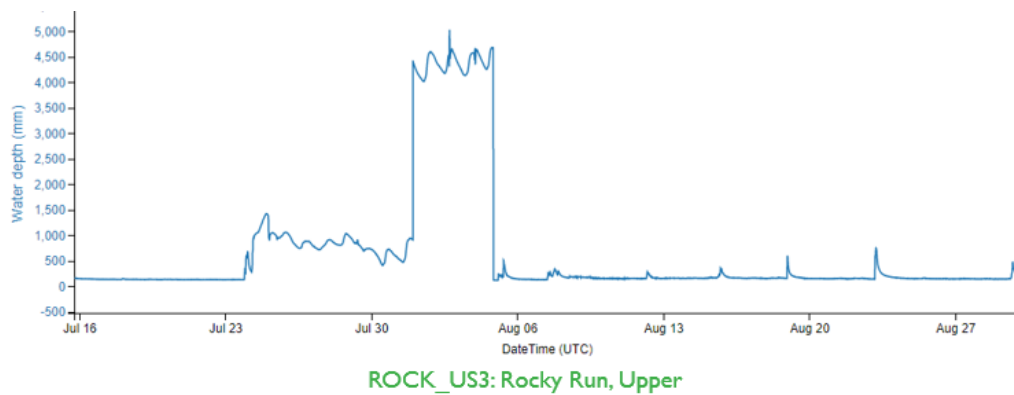
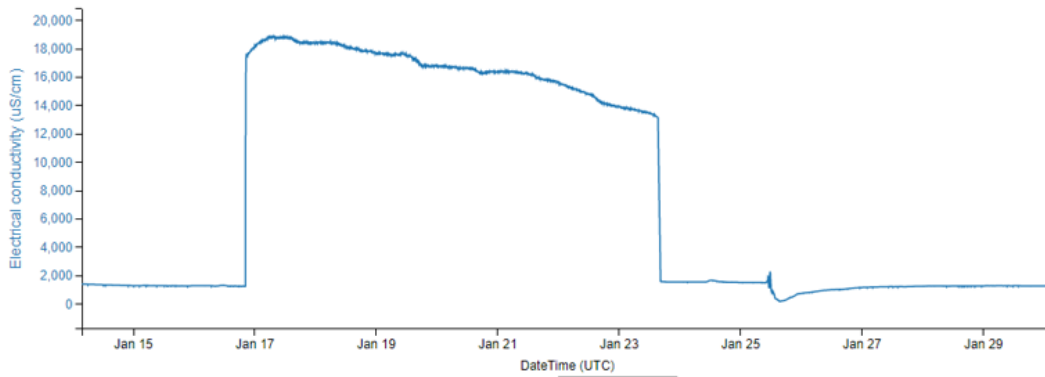
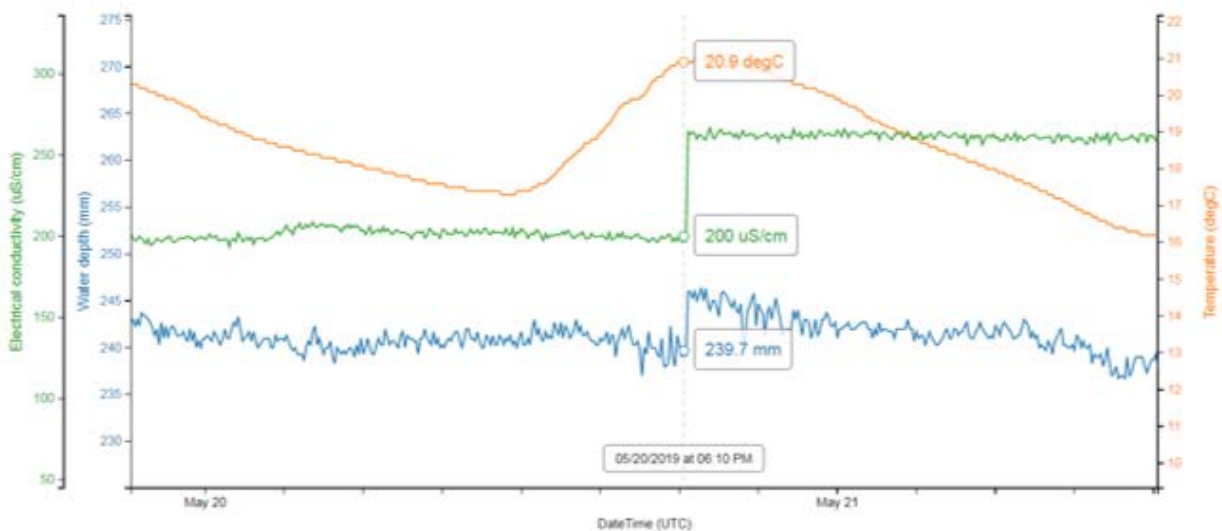


Figure 21: Example data issue. Material wedged into slot of CTD sensor putting pressure on the pressure transducer causing artificially high depth readings.



BCGCIS: Goose Creek at Greenfield Park

Figure 22: Example data issue. CTD sensor buried in fine sediment from landscaping facilities lot (possibly contaminated with salt or other contaminants) causes extreme rise in conductivity. Conductivity decreases when the sensor is excavated from the sediment.



BCPC2S: Pike Creek at Independence School

Figure 23: Example data issue. Sensor covered in algae and debris. Shows immediate increase in conductivity (green) and depth (blue) after cleaning.

Acknowledgements

This work, “TU EnviroDIY Monitoring Station Manual V1.0”, is a derivative of “[EnviroDIY Knowledge Base](#)” by Stroud Water Research Center, used under [CC BY-SA](#). “TU EnviroDIY Monitoring Station Manual V1.0” is licensed under CC BY-SA by Trout Unlimited.

We would like to thank Stroud Center for their support of the development of this manual and TU’s EnviroDIY monitoring efforts.

Other Resources

[Stroud Supplemental Sampling, Rating Curves and Loads Guidance](#)

[Stroud EnviroDIY Knowledge Base](#)

[EnviroDIY Forum](#)

[Stroud Station Installation Videos](#)

[Meter Hydros21 Manual](#)

Appendix A

Other Supported Sensors

[Turner Turbidity Plus](#): Turbidity sensor with integrated wiper.



[MaxBotix MaxSonar Ultrasonic Rangefinder](#): Installed on bridges or other fixed structures above stream surface. Assesses stream stage/depth by measuring the distance to the stream surface.



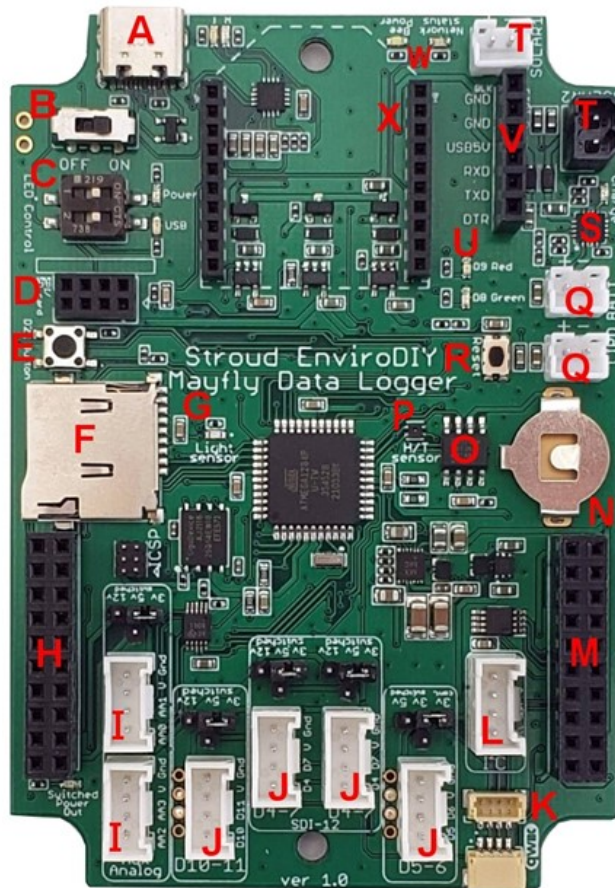
[Yosemitech Y502-A Dissolved Oxygen Sensor](#) (in development): Optical dissolved oxygen sensor.



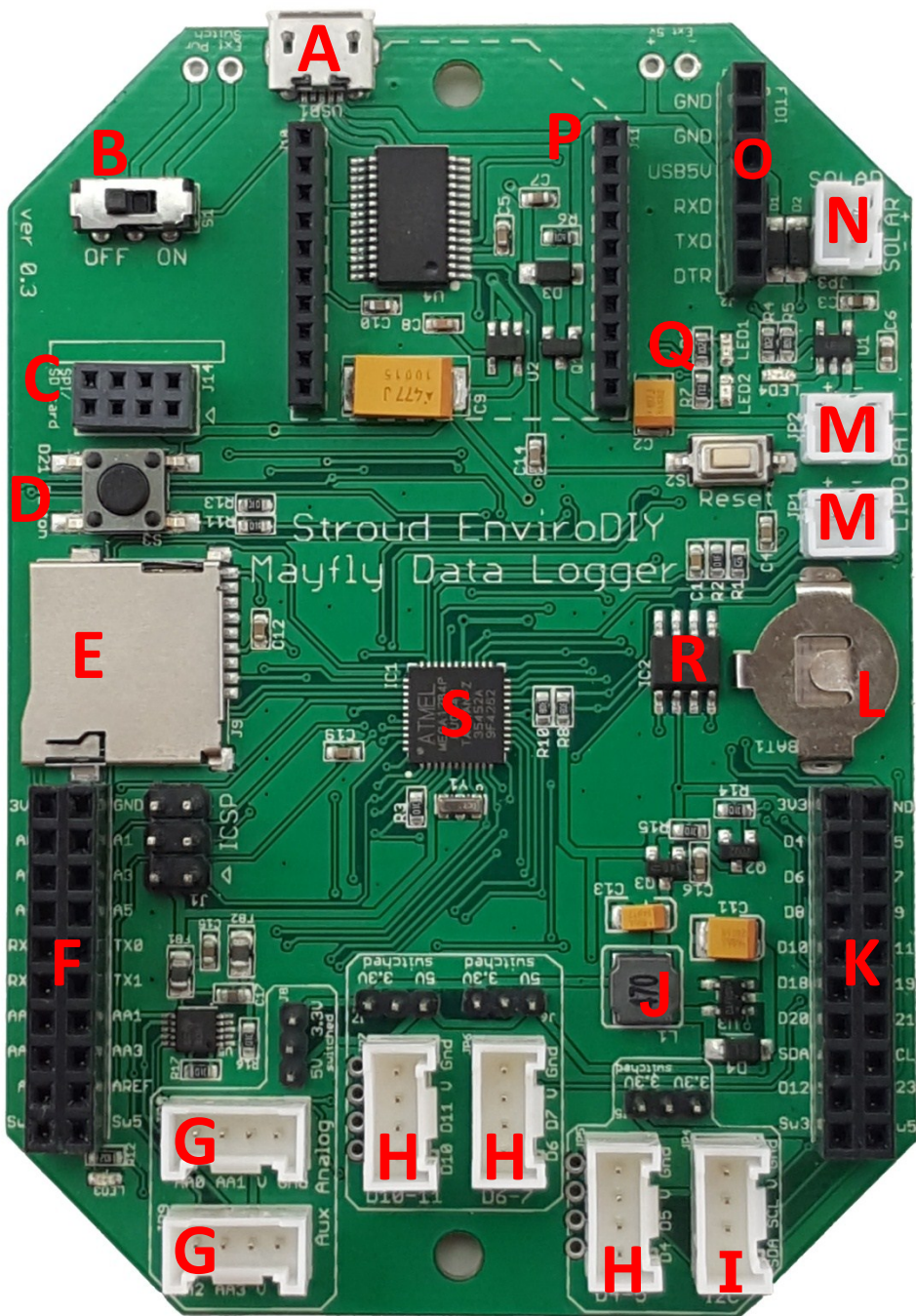
Appendix B

Mayfly Board Anatomy

Features of the EnviroDIY Mayfly Data Logger v1.0



A	USB-C port – connect a standard USB-C cable to a computer for programming the Mayfly using the Arduino IDE software
B	Power switch – turns the Mayfly board on and off
C	Power LEDs and DIP switches – indicate board power and allow for enabling/disabling of LEDs
D	microSD adapter connector – socket for vertical microSD memory card adapter board
E	User Pushbutton – connected to pin D21 for user-defined input
F	MicroSD card socket – socket for storing data on a standard microSD memory card
G	Light sensor – built-in sensor for basic analog ambient light measurement
H	Analog pin header – access to the Mayfly's power, ground, & analog pins
I	Auxiliary ADC Grove connectors – pairs of Auxiliary Analog (ADS1115) pins along with ground and power
J	Digital pin Grove connectors – pairs of digital pins along with ground and power, for connecting sensors and Grove accessories
K	Qwiic connectors – two sockets for connecting Qwiic-compatible devices
L	I2C port Grove connector – connection for devices that use the I2C protocol
M	Digital pin header – access to the Mayfly's power, ground, & digital pins
N	Clock battery – socket for CR1220 lithium battery to keep clock chip (O) running when no other power is connected to Mayfly
O	Real-time clock – DS3231 clock module with on-board temperature sensor, retains the date and time after initial programming
P	Humidity/Temperature sensor – SHT40 digital humidity/temperature sensor
Q	LiPo battery connectors – JST socket for connecting 3.7v Lithium Polymer (LiPo) rechargeable battery. Additional socket is for providing power to high-current peripheral devices
R	Reset button – used to reset (restart) the board sketch
S	Solar charger chip and charge LED – uses either solar or USB power to charge the LiPo battery, yellow LED indicates charging
T	Solar panel connectors – sockets for connecting 6v solar panel for charging the LiPo battery (1 JST & 1 quick connect, use only 1)
U	Red & Green LEDs – User-programmable LEDs for providing visual feedback, connected to pins D8 (green) and D9 (red)
V	FTDI programming header – alternative port for programming board using an external FTDI adapter
W	Bee module network status LEDs – optional indicators for Bee module power and network status
X	Bee module socket – connection port for various telemetry modules that use the Bee footprint (mesh radio, WiFi, cellular)



Features of the Mayfly Data Logger v0.5

A	MicroUSB port – connect a standard MicroUSB cable to a computer for programming the Mayfly using the Arduino software
B	Power switch – turns the Mayfly board on and off
C	microSD/SPI connector – socket for vertical microSD memory card adapter board or other SPI devices
D	Pushbutton – connected to pin D21 for user-defined input
E	microSD card socket – socket for storing data on a standard microSD memory card
F	Analog pin header – access to the Mayfly’s power, ground, & analog pins, and also the four Auxiliary 16-bit Analog-to-Digital converter pins
G	Auxiliary ADC Grove connectors – pairs of Auxiliary Analog pins along with ground and power (3.3v or 5V)
H	Digital pin Grove connectors – pairs of digital pins along with ground and power (3.3v or 5v), for connecting sensors and Grove accessories
I	I²C port Grove connector – connection for any devices that use the I²C protocol
J	5-volt boost converter – generates 5v for powering external sensors
K	Digital pin header – access to the Mayfly’s power, ground, & digital pins
L	Clock battery – socket for CR1220 lithium battery to keep clock chip (R) running when no other power is connected to Mayfly
M	LiPo battery connectors – JST socket for connecting LithiumPolymer (LiPo) rechargeable battery. Additional socket is for providing power to high-current peripheral devices
N	Solar panel connector – JST socket for connecting 6v solar panel for charging the LiPo battery
O	FTDI programing header – alternative port for programming board using an external FTDI adapter instead of using the Mayfly microUSB port
P	Bee module socket – connection port for various telemetry modules that use the Bee footprint (mesh radio, WiFi, cellular)
Q	Red & Green LEDs – LEDs for providing visual feedback, connected to pins D8 (green) and D9 (red)
R	Real-time clock – DS3231 clock module with on-board temperature sensor, retains the date and time after initial programming, requires battery (L)
S	Processor – ATmega1284p microprocessor

Appendix C

Monitor My Watershed Sensor Data Manual

Monitor My Watershed Sensor Data Manual

<http://wikiwatershed.org/help/sensor-help/>

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1. Introduction

This document was last updated on February 25, 2020.

[Monitor My Watershed](#)® lets you share and explore sensor data from the [EnviroDIY](#)™ environmental science and monitoring community and macroinvertebrate data from the [Leaf Pack Network](#)®. Monitor My Watershed is part of the [WikiWatershed](#)® Toolkit, an initiative of Stroud™ Water Research Center.

Our vision is that the sharing of ideas and experiences by the Monitor My Watershed community will result in open-source data sharing and collection tool that is easy to learn and easy to use. Our goal is that this resource will create a wealth of high-quality, real-time data that transforms the practice of environmental science, resource monitoring, and watershed protection.

*This document explains how to use Monitor My Watershed to explore EnviroDIY sensor data. For tips on exploring **Leaf Pack Network macroinvertebrate data**, please [consult this document](#).*

2. Key Terms

- [EnviroDIY](#): A community for do-it-yourself environmental science and monitoring. EnviroDIY is part of the WikiWatershed® Toolkit (see below).
- [WikiWatershed](#): A web toolkit designed to help citizens, conservation practitioners, municipal decision-makers, researchers, educators, and students advance knowledge and stewardship of fresh water. WikiWatershed is an initiative of Stroud Water Research Center.
- [Leaf Pack Network](#): An international network of teachers, students, and citizen monitors investigating their local stream ecosystems. Leaf Pack Network is part of the WikiWatershed Toolkit.
- [Mayfly Data Logger](#): A user-programmable microprocessor board that is fully compatible with the Arduino IDE software; the data logger used in an EnviroDIY Sensor Station.
- [Times Series Analyst](#): A component of Monitor My Watershed where raw data from sensor stations are collected, analyzed, compared, and graphed. TSA allows users to make graphs that compare several variables over customizable time periods.
- Site code: A brief and unique text string that identifies a sampling site (e.g., "DEL_PHIL").
- Site name: A more descriptive name for a sampling site (e.g., "Delaware River near Phillipsburg").
- SL### (Stroud Logger###): Unique identifier of an EnviroDIY Sensor Station built and deployed by Stroud Water Research Center.
- Time-series data: Data points collected over time at equally spaced intervals. For EnviroDIY Sensor Stations measurements are recorded every five minutes.
- Continuous data: Term used interchangeably with "time-series data;" it refers to the continuous stream of data generated at specific time intervals.
- Discharge: Quantity of water flowing in a stream over time (m^3/s or ft^3/s).
- Turbidity: Measure of light passage through water (i.e., measure of the cloudiness of water). Measured in Nephelometric Turbidity Units (NTU) and others (e.g., JTU, FNU).
- Conductivity: A measure of water's capability to pass electrical flow; it is directly related to the amount dissolved material (ions) in the water. Measured as microsiemens per centimeter ($\mu\text{S}/\text{cm}$).
- CTD sensor: A sensor that measures Conductivity ($\mu\text{S}/\text{cm}$), Temperature ($^{\circ}\text{C}$), and Depth (mm).

3. Account Information

NOTE: It is not necessary to create an account to view data on Monitor My Watershed. You must have an account in order to share data. It might also be helpful to have an account if you regularly check on specific sites owned by other users (see Section 4.4 for instructions on how to follow sites).

3.1. Create an Account

To create an account, click the “Sign Up” button on the Monitor My Watershed homepage or click “Sign Up” in the main menu. Fill out the following fields.

Your Name

Please note that **your first and last names will be displayed publicly** with your data; if you do not want your name to be visible, please do not sign up for an account.

Email Address

This will be used for password recovery (not for logging in!) and will not be visible to the public.

Username

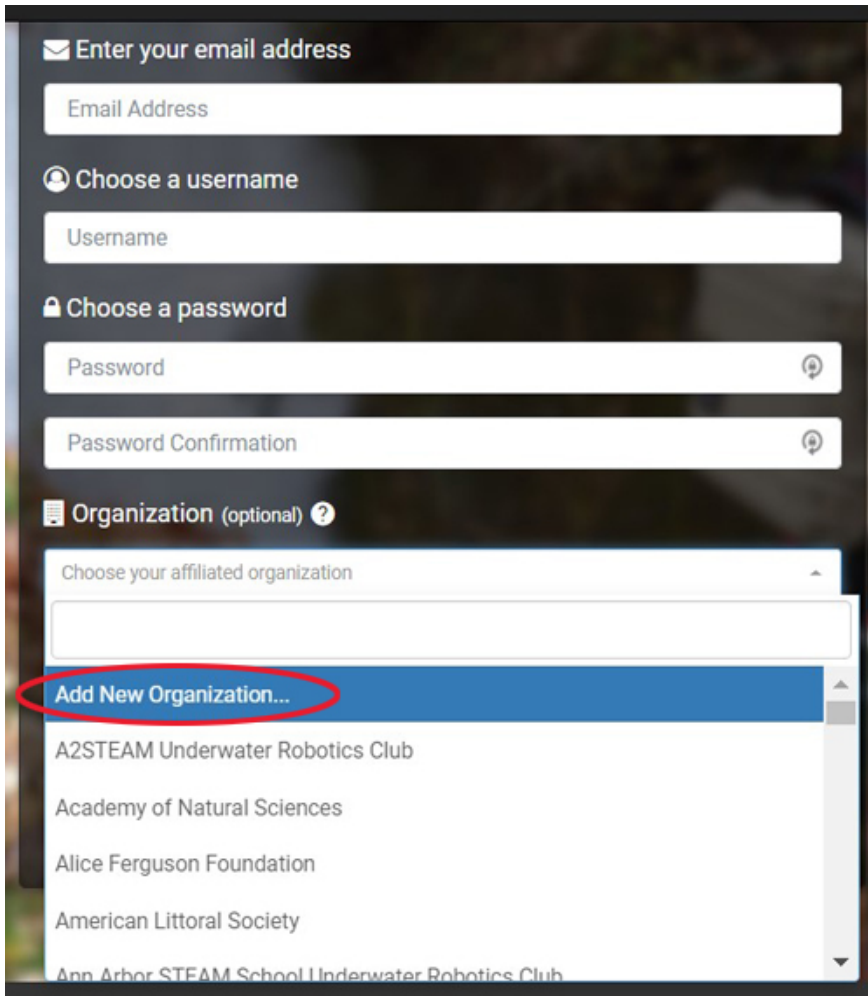
Choose a username. Make a note of it — you will need it to login because **the site does not currently allow you to log in with your email address.**

Password

Choose and confirm a strong password.

Organization

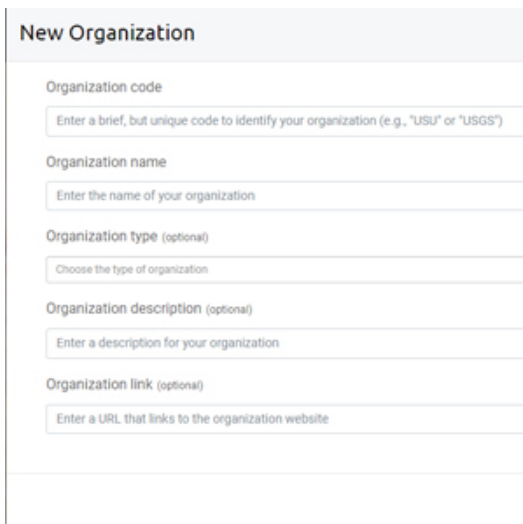
If applicable, select the organization you are with. If you are independent of an organization, you do not need to include one. To avoid duplicate entries for a single organization, please check the list of existing organizations by typing your organization name in the box. If you see “No results found,” clear your entry, click on the drop-down list, and choose “Add New Organization” (Figure 1). You will be prompted to add in about your organization, including an organization code, name, organization type, description, and organization link (Figure 2). People will be able to search the data by organization so **make sure you do not create a duplicate entry for an existing organization.**



The image shows a registration form with the following fields and options:

- Enter your email address**: A text input field labeled "Email Address".
- Choose a username**: A text input field labeled "Username".
- Choose a password**: Two text input fields, one labeled "Password" and another labeled "Password Confirmation".
- Organization (optional) ?**: A dropdown menu labeled "Choose your affiliated organization". The option "Add New Organization..." is highlighted with a red circle. Below it, a list of organizations is visible, including "A2STEAM Underwater Robotics Club", "Academy of Natural Sciences", "Alice Ferguson Foundation", "American Littoral Society", and "Ann Arbor STEAM School Underwater Robotics Club".

Figure 1. Add new organization.



The "New Organization" form contains the following fields:

- Organization code**: A text input field with the placeholder "Enter a brief, but unique code to identify your organization (e.g., 'USU' or 'USGS')".
- Organization name**: A text input field with the placeholder "Enter the name of your organization".
- Organization type (optional)**: A text input field with the placeholder "Choose the type of organization".
- Organization description (optional)**: A text input field with the placeholder "Enter a description for your organization".
- Organization link (optional)**: A text input field with the placeholder "Enter a URL that links to the organization website".

Figure 2. New organization information.

Terms of Use

You must agree to the Terms of Use in order to register. If you wish to read the terms, you may click the link in the agreement on the Sign Up page, or [use this link](#). Accept the terms and click the Register button.

3.2. Edit Your Account

If you need to edit your account after registration:

1. Log into Monitor My Watershed.
2. Click the “Logged in as (username)” link in the main menu, then click “My Account.”
3. Click the pencil icon.
4. Make the desired changes and click “Save Changes.”

4. My Sites

The **My Sites** page becomes available in the Monitor My Watershed menu when a user creates an account (Figure 3). It displays the user’s registered sites and the sites the user follows, on a map and in list form. This page also includes a button to register a new site.

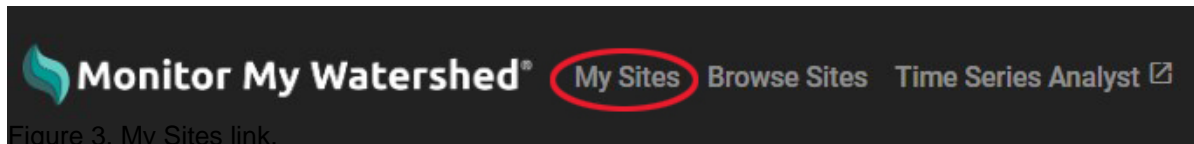


Figure 3. My Sites link.

4.1. Register a Site

1. Click on “My Sites” in the Monitor My Watershed main menu.
2. Click the “Register a New Site” button.
3. Fill out the data fields for your site.
 - Site code: enter a brief and unique text string to identify your site (e.g., “DelRiv_Phil”).
 - Site name: enter a brief but descriptive name for your site (e.g., “Delaware River near Phillipsburg”).
 - Site type: select the type of site you are deploying to from the menu.
 - Stream name: *it is encouraged to enter a name even if it is ‘unknown tributary XXX.’
 - Major watershed and sub-basin (optional)
 - Closest town (optional)
 - Notes (optional)
 - Latitude and longitude: enter your lat/long in decimal degrees OR zoom in on the map, click to place a pin at your site location, and the lat/long will be auto-generated.
 - Elevation and elevation datum: auto-generated from your lat/long.

You may also check a box to be notified if the website stops receiving sensor data from your site.

4.2. Edit a Site

1. Click on “My Sites” in the Monitor My Watershed main menu.
2. Scroll down to find the site you’d like to edit. Click on the Site Code to go to the site page.
3. Once on the site page, click the “Edit” button.
4. Edit your site data and click the “Save Edits” button.

4.3. Delete a Site

1. Click on “My Sites” in the Monitor My Watershed main menu.
2. Scroll down to find the site you’d like to edit. Click on the Site Code to go to the site page.
3. Click the red delete button above the map to delete the experiment.

4.4. Follow a Site

1. Click on “Browse Sites” in the Monitor My Watershed main menu.
2. In the “Browse Data Collection Sites” sidebar, under “Data Types,” check the “EnviroDIY” box.
3. Click on a map marker and then on the “View data for this site” link.
4. Check the “Follow” box in the right corner above the map. The sites you follow will appear on your “My Sites” page, below your registered sites.

5. Browse Sites

The [Browse Sites](#) page allows you to search all of sites streaming data to Monitor My Watershed. Users, regardless if they have an account, can access all information selected from every site in the data portal.

When the **Browse Sites** page is opened, you will see a map with markers indicating different sites around the world. The color and shape of the map markers indicate data age and ownership, as shown in the marker legend (Figure 4). The legend can be toggled open or closed (Figure 5).

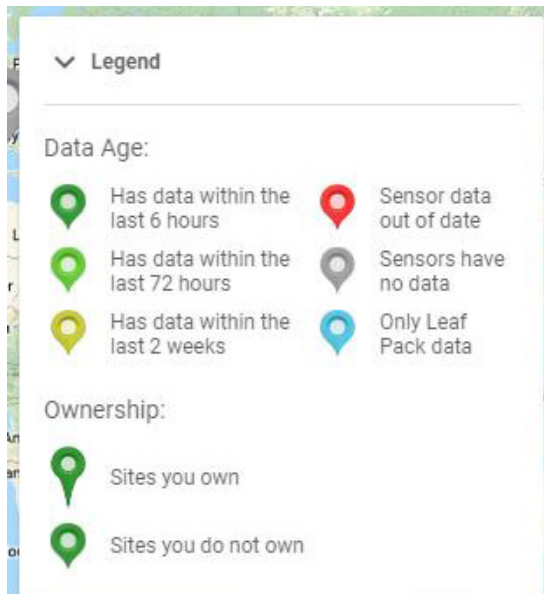


Figure 4. Legend for the Browse Sites page site markers.

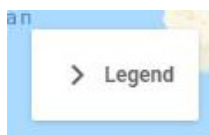


Figure 5. The legend can be toggled open or closed.

5.1. Navigating to a Specific Site

There are several ways to view sites within the *Browse Sites* page. The first option is to use the filter bar on the

left side of the screen. Another option is to use the search bar on the top of the site. The last method is to zoom in on the map and select a site based on a desired location.

Filter Bar

The filter bar on the left side of the screen (Figure 6) allows you to filter sites by data type, organization, and site type. Any and all combinations of information can be selected. After checking the appropriate boxes, the map will display the sites that fulfill the filters selected. You can then click on the site markers for sites you wish to examine further. Clicking the *Clear* button at the top of the filter bar will clear all filters.

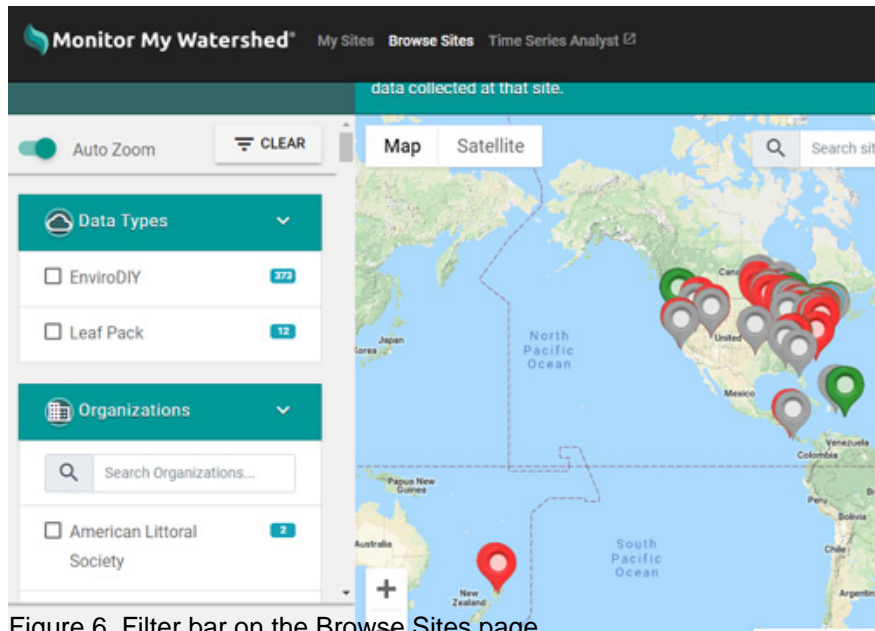


Figure 6. Filter bar on the Browse Sites page.

Search Bar

Using the search bar works well if you know the name of a site you wish on the map. You can type the site name you are seeking into the search bar (Figure 7) and then click on the site marker that pops up on the map. You can then click on the site marker for the site you wish to examine further.

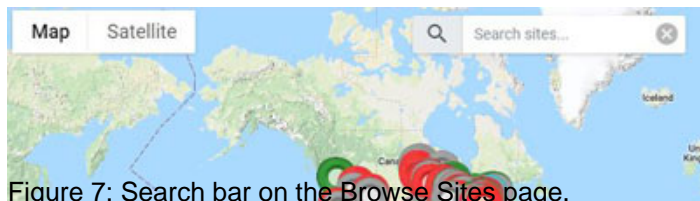


Figure 7: Search bar on the Browse Sites page.

Zooming In

The last option available for navigating the *Browse Sites* page of Monitor My Watershed is to pick an area of the map and zoom in. This option may be best for users who know which area they are interested in, but do not know which organization has the information they require. Zooming in is done by clicking the plus and minus symbols at the bottom left corner of the map (Figure 8).

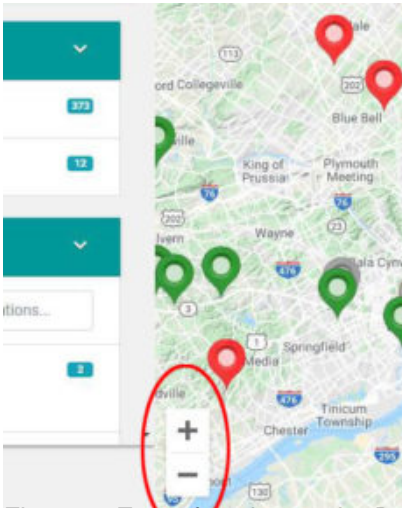


Figure 8: Zoom function on the Browse Sites page.

5.2. View Site Data

Once you have chosen a site you're interested in, click on the site marker to open the pop-up site summary pane. You will see a summary of the site identification information and a **View data for this site** link (Figure 9). Click the link to be taken to the **Site Details** page.

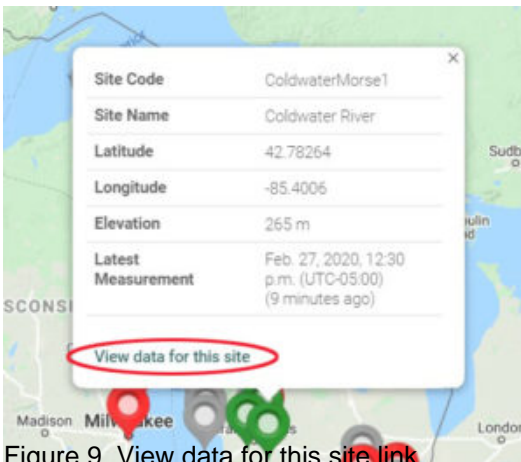


Figure 9. View data for this site link.

5.2.1. Site Identification Information

At the top of the **Site Details** page you will see the site identification information (metadata) for the site. Depending on the information entered when the site was registered, the metadata can include some or all of the following information: name of the individual that registered the site; organization that deployed the sensor/site; registration date; sensor deployment date; site latitude, longitude, and elevation; other elevation datum; site type; stream name; major watershed; sub basin; the closest city/town to the site, and miscellaneous notes provided by the registrar of the site.

5.2.2. Sensor Observations

Scroll down on the **Site Details** (<http://monitormywatershed.org/sites/xxx/>) page, below the site metadata, to see sensor observation data for the site. Depending on the sensor deployed at the site, the data collected could have some or all of the following information:

- Depth of the water where the sensor was deployed (in millimeters).
- Temperature of the water the sensor is located in (in Celsius).
- Conductivity of the water in which the sensor is immersed (?S/cm).
- Temperature of the transmitting station box deployed near the sensor (in Celsius).
- Battery voltage of the measurement equipment.
- Signal strength of the sensor.

You will see graphs showing the last 72 hours of data collected from the sensor (Figure 10). Below the graph you will see the latest observation, the medium in which the sensor is located, and the full name of the sensor.

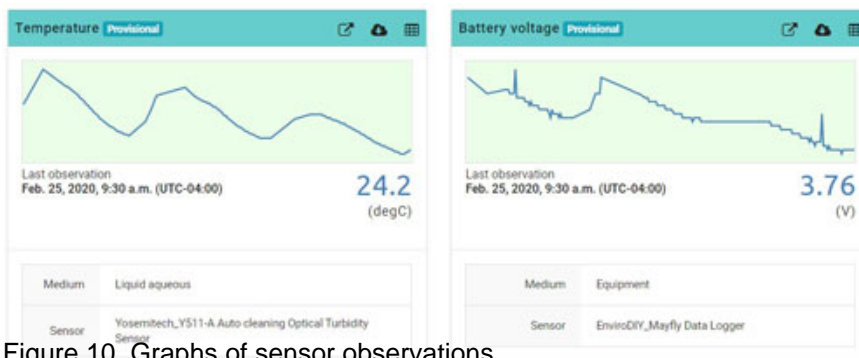


Figure 10. Graphs of sensor observations.

5.2.2.1. View in Time Series Analyst

The first data viewing option is to click the first icon in the graph header (Figure 11) to open Time Series Analyst. See Section 6 for detailed instructions on how to use the Time Series Analyst. *Note: clicking this link will graph only this specific dataset in Time Series Analyst. If you want to graph all of the variables for the site, see the second option in Section 6.1.*



Figure 11. Link to the Time Series Analyst.

5.2.2.2. Download Data

Another data viewing option is to download the data. Click the second icon in the graph header (Figure 12) to download all the data for the selected variable as a CSV file. The file will contain all the data points collected and uploaded by the sensor from the time of its deployment to the current day. Depending on how long the sensor has been deployed, the download may take a long time.



Figure 12. Link to download data as a CSV file.

5.2.2.3. View as Data Table

The last data viewing option is to open a data table. Click the third icon (Figure 13) and the raw data from the sensor from the last 72 hours will be displayed in a pop-up pane. The table contains the sample date and time in Coordinated Universal Time (UCT), the number of hours to adjust to accommodate the time zone, and the data point collected from the sensor.



Figure 13. Link to open the data table.

6. Times Series Analyst

[Time Series Analyst](#) is a powerful tool to evaluate and analyze data found on Monitor My Watershed. You can graph, compare, and analyze multiple variables all on one graph and set custom time frames to analyze data from a specific period of time. Users, regardless if they have an account, can analyze all information selected from every site streaming data to Monitor My Watershed.

6.1. Paths to TSA

There are several different paths to obtaining sensor data for a site in the Time Series Analyst. They are listed here in an order that yields the **least specific to most specific** data views.

Monitor My Watershed Menu > Time Series Analyst Map Tab

(For viewing **all sites** streaming to Monitor My Watershed)

Clicking on **Time Series Analyst** in the Monitor My Watershed menu (Figure 14) will open all sites in the Time Series Analyst **Map** tab. To narrow your focus to a single site, follow the instructions in Section 6.2 (Map tab) or Section 6.3 (Datasets tab).

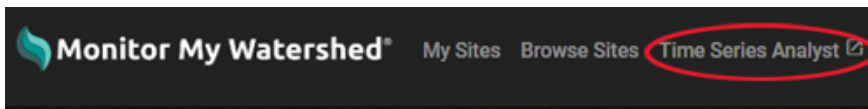


Figure 14. The Time Series Analyst link in the main menu on Monitor My Watershed.

Browse Sites > Selected Site > Time Series Analyst Datasets Tab

(For viewing **all variables for a specific site** streaming to Monitor My Watershed)

Click on **Browse Sites** in the Monitor My Watershed menu to select a site (see Sections 5.1 and 5.2) and then view the last 72 hours of data for that site. Clicking on the Time Series Analyst link (Figure 15) on the Site Details page will take you to the TSA **Datasets** tab with all datasets for that specific site displayed. See Section 6.3 for

what to do next.

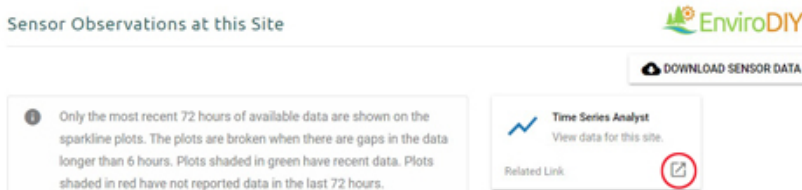


Figure 15. The Time Series Analyst link on the Site Details page.

Browse Sites > Selected Site > Selected Variable > Time Series Analyst Visualization Tab

(For viewing a **single variable for a specific site** streaming to Monitor My Watershed)

Click on Browse Sites in the Monitor My Watershed menu to select a site (see Sections 5.1 and 5.2) and then view the last 72 hours of data for that site. The header above each graph contains three icons. Clicking on the first icon (Figure 16) will take you directly to the Time Series Analyst **Visualization** tab with an expanded graph for that specific variable. See Section 6.4 for what to do next.

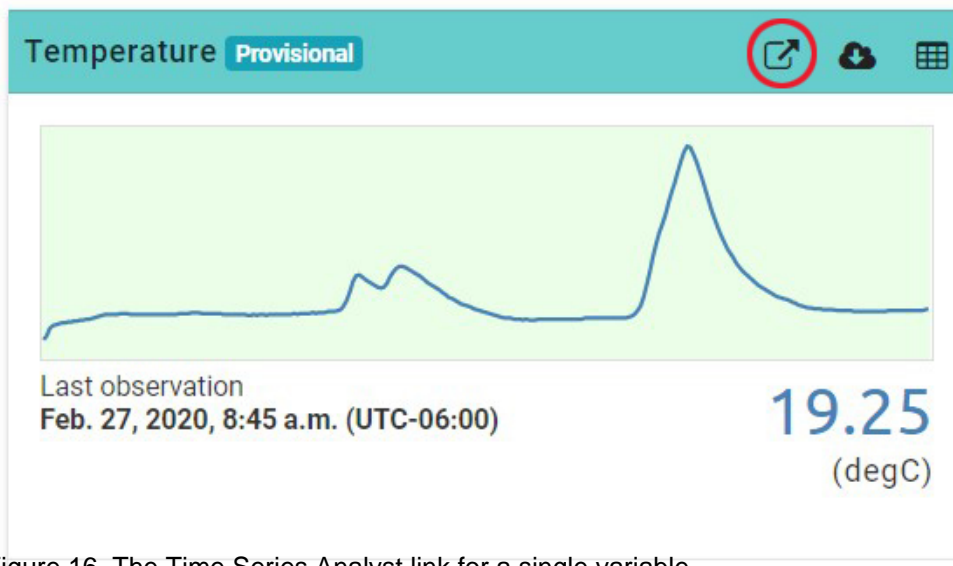


Figure 16. The Time Series Analyst link for a single variable.

6.2. Map Tab

When accessed from the main menu on Monitor My Watershed, the Time Series Analyst will open in the **Map** tab. The map is interactive and can be used to view sites around the world. You can add filters to the map (see Navigation section below). Time Series Analyst displays different markers for different site types. The legend for those markers is show in Figure 17.

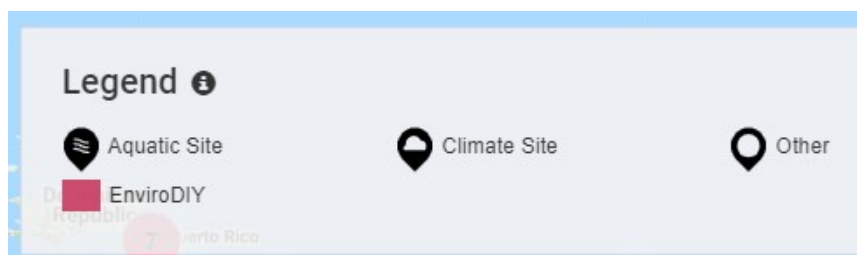


Figure 17. Time Series Analyst legend.

Changing Map Views

The map view can be modified using the **Map** and **Satellite** buttons just below the Map tab (Figure 18). The default map view includes terrain. This can be removed by hovering your cursor over the Map button and unchecking **Terrain**. You can switch to a satellite map by clicking the Satellite button. The default satellite view includes the outlines of each country, province, and/or state on the land mass. These outlines can be removed by hovering your cursor over the Satellite button and unchecking **Labels**.

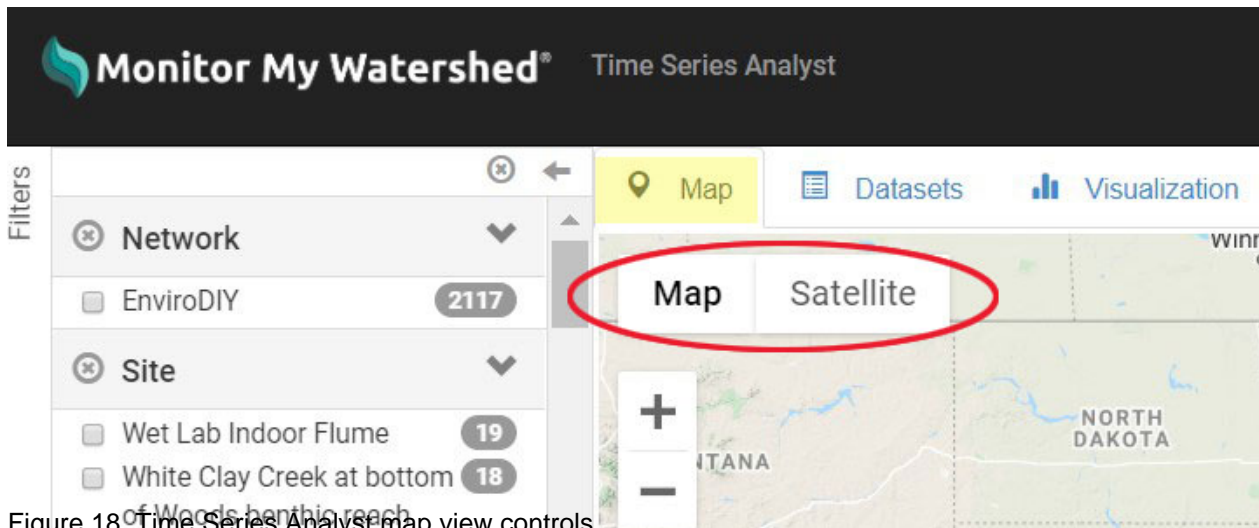


Figure 18. Time Series Analyst map view controls.

Navigating in the Map Tab

There are three ways to navigate in the *Time Series Analyst* Map tab: using the filter bar, clicking on an individual site marker of interest, or zooming in on the map and selecting a site based on a desired location.

Filter Bar

Using the filter bar works well if you wish to locate specific information. Use the filter bar on the left side of the screen (Figure 19) to filter by network, site, variable category, specific variable, quality control level, and/or variable level. Any and all combinations of information can be selected. After checking the appropriate boxes, the map will display the sites that fulfill the filters selected. You can then click on the site marker of the site you wish to examine further.

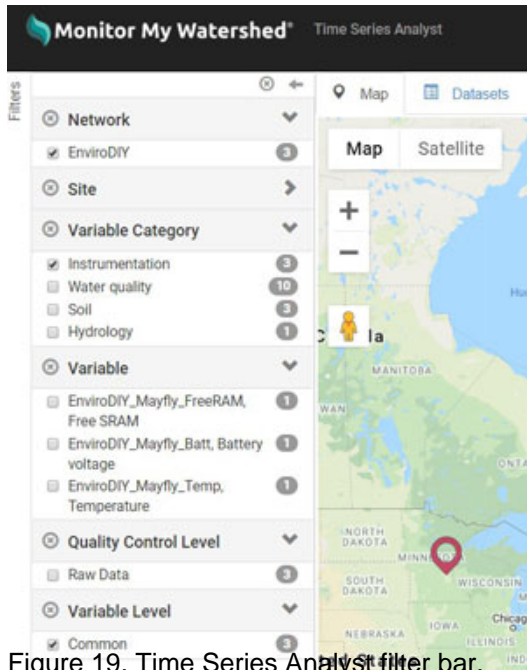


Figure 19. Time Series Analyst filter bar.

Site Selections

Alternatively, if you wish to locate a specific site on the map you can click on site markers in an area of interest. Continue clicking on markers until you find the site you wish to examine further.

Zooming In

The last option available for navigating the *Map* tab is to pick an area of the map and zoom in. This option may be best for users who know which area they are interested in, but do not know which organization has the information they require. Zooming in is done by clicking the plus and minus symbols at the top left corner of the map (Figure 20).

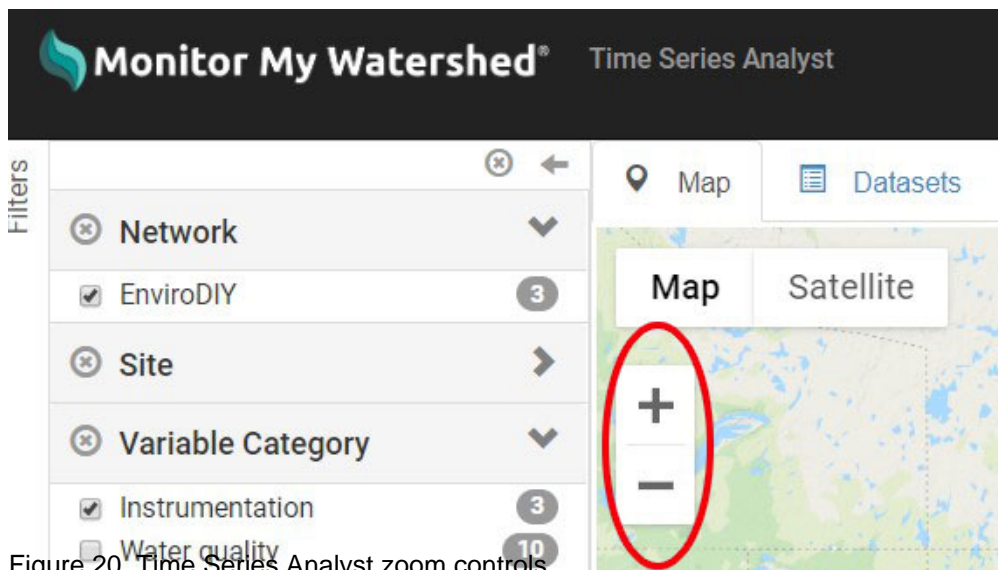


Figure 20. Time Series Analyst zoom controls.

View Dataseries

Once you've found a site you're interested in, click on the site marker and a box will pop up showing site summary information. Clicking on the **View Dataseries** button (Figure 21) will open site data in the **Datasets** tab. See Section 6.3 for information on using the Datasets tab.

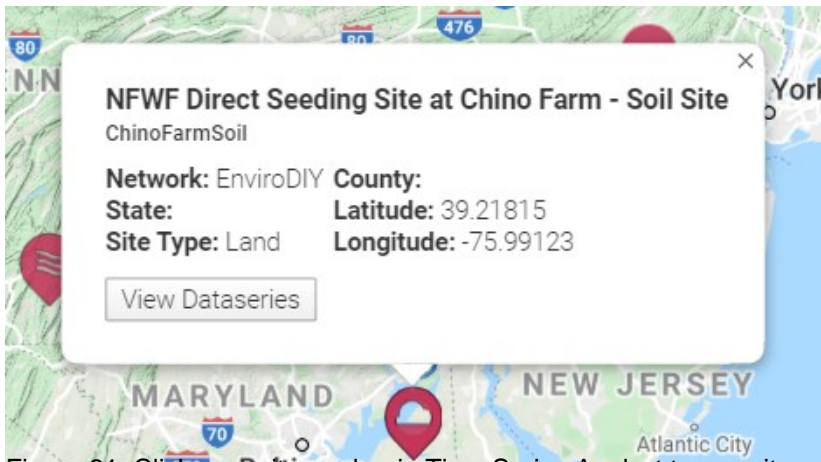


Figure 21. Click on a site marker in Time Series Analyst to see site summary and a link to view data.

6.3. Datasets Tab

You can bypass the Map tab if you know which site, sensor, or variable you are looking for. When you click on the **Dataset** tab you are presented with all of the data available on Monitor My Watershed and you can use the **filter bar** on the left to narrow your search (Figure 22).

Plot	Series	Network	Site Code	Variable Code
<input type="checkbox"/>	1	EnviroDIY	GermantownFS	MaxBotix_MB7386_Distance
<input type="checkbox"/>	2	EnviroDIY	GermantownFS	Decagon_5TM_VWC
<input type="checkbox"/>	3	EnviroDIY	GermantownFS	Decagon_5TM_Temp
<input type="checkbox"/>	4	EnviroDIY	GermantownFS	EnviroDIY_Mayfly_Temp

Figure 22. Time Series Analyst Datasets tab with filter bar.

When searching for a specific site by name, the most effective way to locate the site is to select **Show More** under the **Sites** filter in the filter bar. You can then hit **Ctrl+ F** and type in the name of the site they are looking for. This same method (**Ctrl +F** to find specific pieces of information) can be used to search through all presented data on the site.

Five buttons are displayed along the top right-hand side of the Datasets tab: Show All, Show Selected, Clear Selected, Export Selected (.zip), and Show/Hide Columns (Figure 23).



Figure 23. Time Series Analyst Dataset tab view controls.

- Click the **Show All** button to display all variables from all sites and sensors. Users can use the filter bar on the left to find and select new site information to display. When you select Show All, any previously selected data will stay checked.
- To display specific datasets, check boxes in the Plot column and then click the **Show Selected** button.
- Click the **Clear Selected** button to clear the checkboxes in the Plot column.
- Click the **Export Selected** button to download the selected information as a zip file containing separate CSV files for each dataset. You can download up to five datasets at a time.
- Click the **Show/Hide Column** button to add or remove columns from the data you are observing. Columns on the table can be added or removed to help you locate the specific information more quickly. Adding and removing columns can also streamline the table you see when you launch the Visualization tab.

After you have selected the datasets you wish to graph (up to five at a time), you can then click **Visualization** tab.

6.4. Visualization Tab

The **Visualization** tab (Figure 24) allows users to plot selected variables. This function allows users to select data over a specific time period, and graph up to five variables on the same graph. Time Series Analyst auto-generates the increments on each axis. When several variables are selected with different units, the application will create a graph with appropriate units depending on the type of graph.

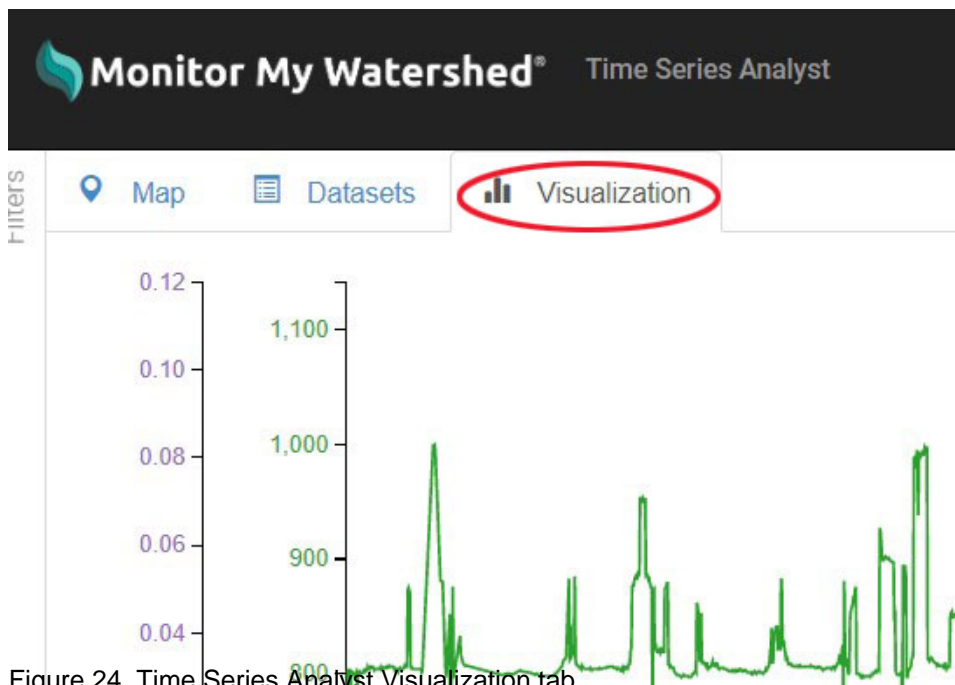


Figure 24. Time Series Analyst Visualization tab.

6.4.1. Selecting Data to Visualize

The **Visualization** tab displays data you select in the **Datasets** tab (unless you come directly to the Visualization tab via the third path in Section 6.1). If you select the Visualization tab without first adding variables from the Dataset tab you will see a blank pane with empty legend and summary statistics boxes. See Section 6.3 for several ways to select data to visualize.

6.4.2. Plot Options

By default, the plot will show data for the last month as a time series. The **Plot Options** box (Figure 25) allows you to select different dates and different visualization types. Using the buttons at the top of the box you can view the data collected over the last week, over the last month, or over the entire period of time the sensor has been collecting data. You can also plot a custom date range using the Begin Date and End Date boxes. You can also plot a custom date range using the Begin Date and End Date boxes.

You can also use the Visualization Type menu to select the type of graph you wish to view: Time Series, [Histogram](#), or [Box and Whisker](#).

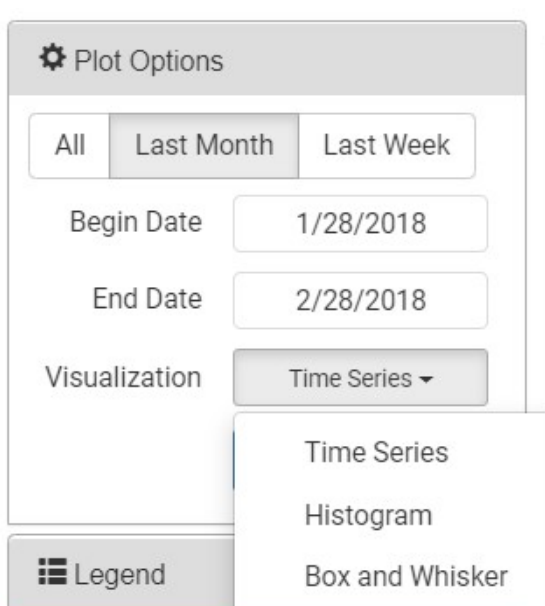


Figure 25. Time Series Analyst Visualization tab, Plot Options box.

6.4.3. Visualization Legend

The **Visualization** tab legend displays the following information for each dataset in the plot: sensor name, variable name, site code, site name, and quality control level (Figure 26). Plot lines for the variables are assigned a specific color according to the order in which they were selected in the Datasets tab. The order of the colors is as follows: first = blue; second = orange; third = green; fourth = red; and fifth = purple.

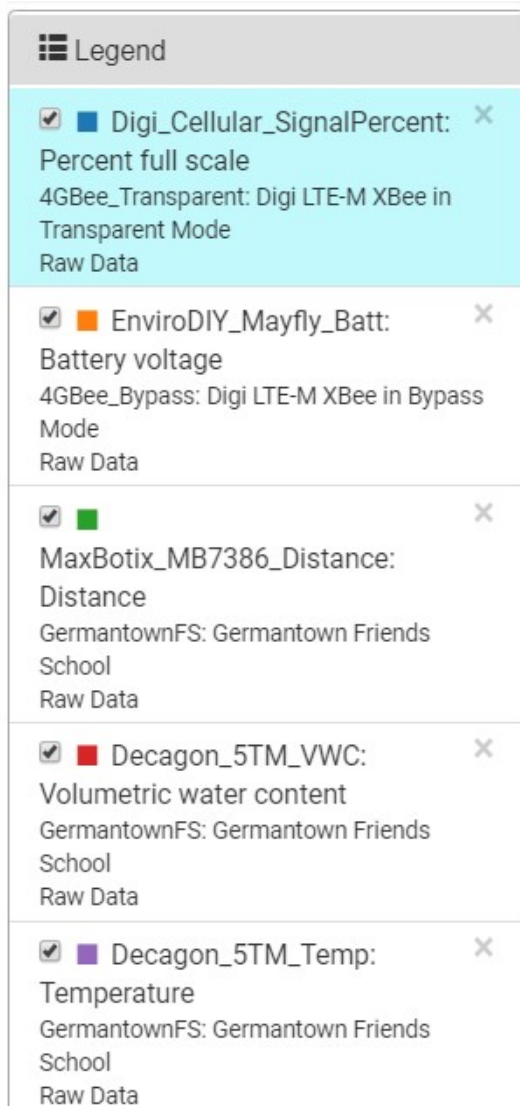


Figure 26. Time Series Analyst Visualization tab legend.

6.4.4. Summary Statistics

Time Series Analyst generates statistical data for the data and time frame selected by the user. The **Summary Statistics** box includes Arithmetic Mean, Geometric Mean, Maximum, Minimum, Standard Deviation, and the total number of observations. It also includes 10%, 25%, 50% (median), 75%, and 90% values.

When viewing multiple variables in a single graph, the Summary Statistics defaults automatically to the variable listed first (highlighted by a blue background, Figure 27). To see the Summary Statistics for any of the other variables, click on the panel for that variable in the Legend box. The blue background will move to that variable and the statistics for the newly selected variable will appear in the Summary Statistics box (Figure 28).

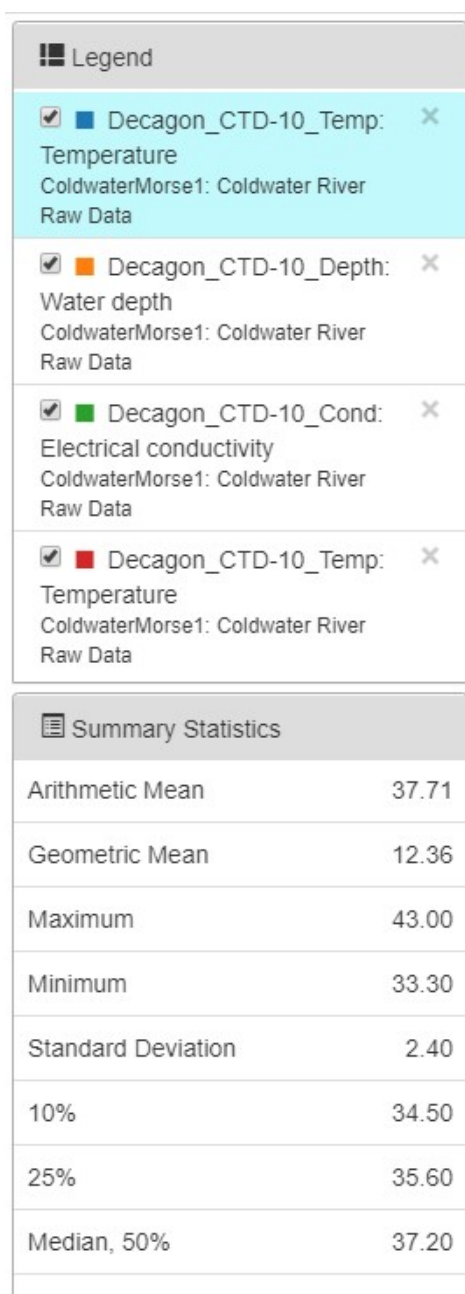


Figure 27. By default, the Summary Statistics box shows data for the first variable in a multivariable plot.

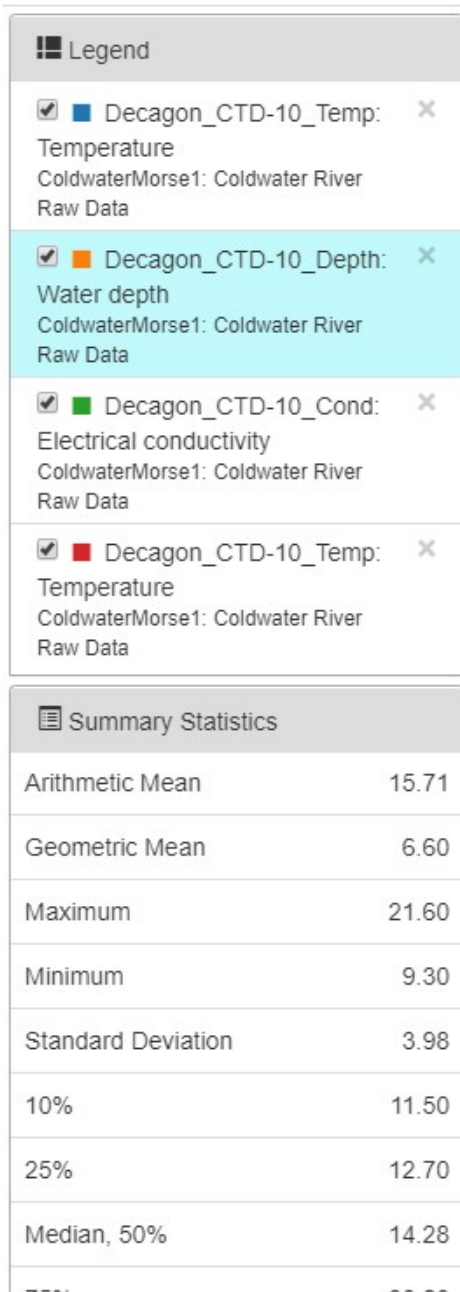


Figure 28. Click on a different variable in the legend box (as shown by blue background) to display summary statistics for that variable.

6.4.5. Graph Examples

Time Series Analyst produces a primary graph (Figure 29) based on the period of time and the graph type you select. It auto-generates the increments on each axis. When several variables are selected with different units, the application will create a graph with the appropriate units depending on the type of graph.

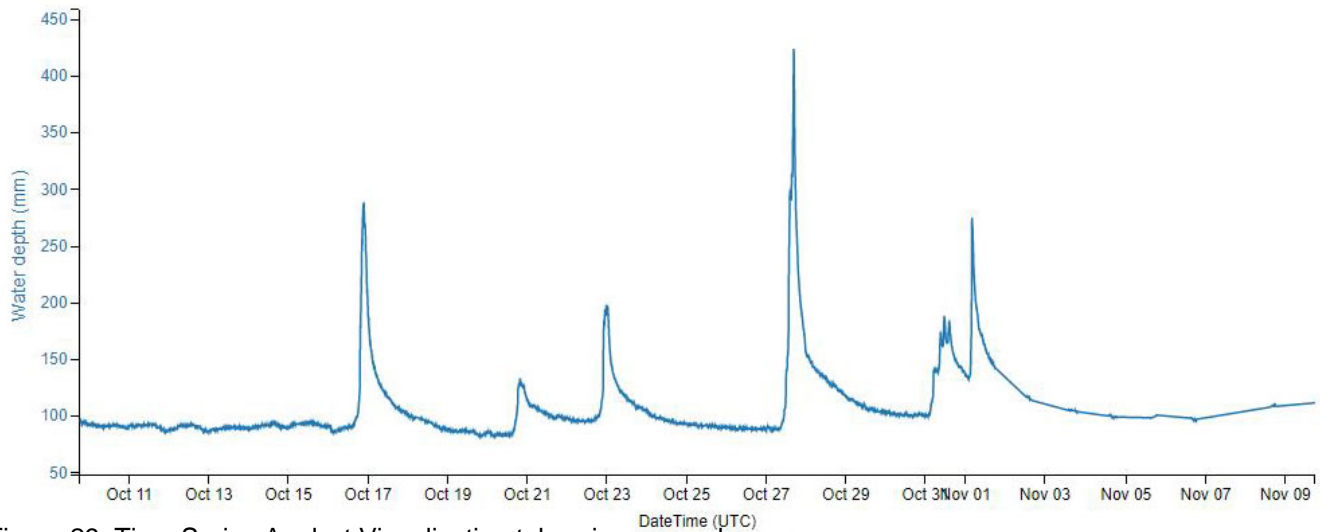


Figure 29. Time Series Analyst Visualization tab, primary graph.

Time Series Analyst also allows you to zoom in and focus on one particular area of the timeline by manipulating a secondary graph. Zoom in on this graph by left-clicking and holding on a mouse or touchpad, and then dragging the mouse on the target area. Doing this will result in a little gray box (Figure 30). The area selected will be magnified on the main graph. You can then further analyze a specific period of time within the selected data window.



Figure 30. Time Series Analyst Visualization tab, secondary graph with timeframe selected for zoom.

7. Sending/Uploading Sensor Data

After registering your site, you're ready to add sensor data to it.

Sending Data From a Data Logger

You can send sensor data from an Arduino data logger by following the detailed instructions in the EnviroDIY GitHub repository, [Modular Sensors wiki](#).

REST POST Request Syntax

REST POST request syntax examples can be found in [documentation](#) on the Monitor My Watershed GitHub repository.

Uploading CSV Sensor Data

1. You must be logged in to [MonitorMyWatershed.org](#) and be the owner of the site in order to upload data. (Detailed instructions for registering a site on Monitor My Watershed are available in Section 4.1.)
2. Make sure that you've registered all the variables for your site.
 1. Add sensors/variables as needed by selecting "Manage Sensors" in the Sensor Observations section of your site page and adding them with the "+" button.
 2. Note: many sensors can record multiple types of data or "variables" – e.g., conductivity and

temperature. For those sensors, you must add every variable you're measuring independently.

3. Create a comma delimited data file (csv) with your sensor values and time stamps
 1. Only include data from a single site; do not mix data from multiple sites!
 2. The timestamp must be in the first column with data values in subsequent columns.
 3. The timestamp must be formatted as yyyy-mm-dd HH:MM:SS (e.g., 2019-07-31 11:15:00). If you are editing your file in Excel, you must manually select this date format. *By default, Excel will format the timestamp incorrectly!* To manually select the correct date format:
 1. Select the cells containing timestamp data.
 2. Right-click and select "Format Cells."
 3. Make sure you are on the "Number" tab and that "Custom" is selected in the Category list.
 4. The "Type" field will show m/d/yyyy h:mm. DELETE that format completely and type in yyyy-mm-dd HH:MM:SS (Figure 31).

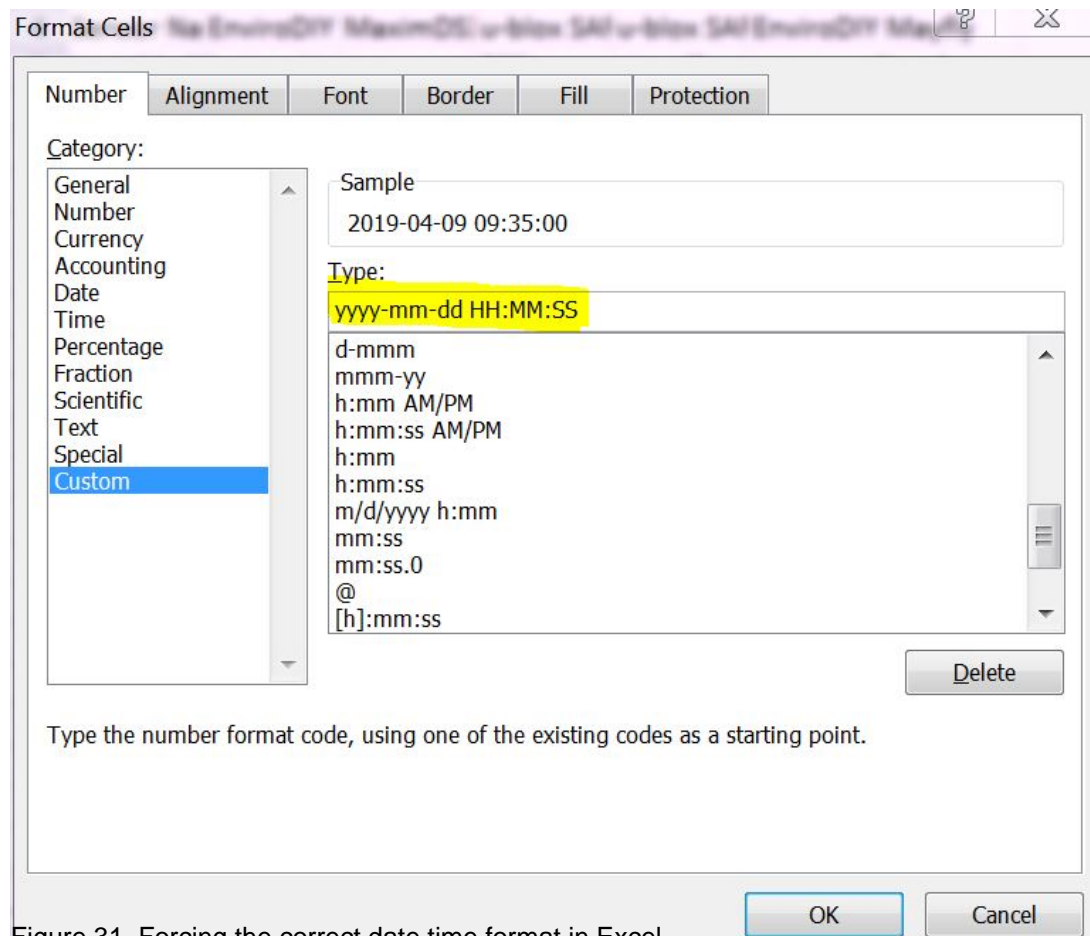


Figure 31. Forcing the correct date time format in Excel.

5. Click OK to save the changes. **Please note: the "Custom" time format is not persistent.** If you open the file again with Excel it will revert back to Excel default timestamp format and you will have to change it to yyyy-mm-dd HH:MM:SS again. You may consider using a text editor like Notepad or Notepad++ for any subsequent file editing.
4. All of your timestamps must be in the same time zone – that is, not corrected for daylight savings time. If your timestamps are in local time (with a daylight savings time adjustment) you must recalculate the times to be in a single time zone.
4. Add the following header rows to the top of your CSV:

Sampling Feature				
UUID: [sampling feature UUID]				
Date and Time in				

UTC[timezone]				
Result UUID:	[variable 1 UUID]	[variable 2 UUID]	[variable 3 UUID]	...
[yyyy-mm-dd HH:MM:SS]	[data]	[data]	[data]	
...

1. Replace [sampling feature UUID] with the sampling feature UUID shown at the bottom of the site information on your site page.
2. A UUID is a Universally Unique Identifier (also called a GUID or Globally Unique Identifier). They are 36 characters long and are made of numbers 0-9 and the letters a-f, e.g., 12345678-abcd-1234-efgh-1234567890ab.
3. Hint: Clicking on the text of the Sampling Feature UUID on the page will cause it to be copied to your clipboard.
4. Replace [timezone] with the correct UTC offset of your data. Eastern Standard Time would be UTC-5.
5. Replace [variables 1 UUID] (and subsequent variables) with the UUID of those variables.
6. The UUID for each variable is shown below the plot of recent data for that variable on the site page. You can also see the UUID of a variable at the top of the window when editing an already existing variable (but not when creating a new one).
7. Hint: the UUIDs necessary to upload data to Monitor My Watershed will be visible under the plot for each variable or all together via the white button at the top of the page (Figure 32). You have to be logged in and the owner of the site in order to get these UUIDs. If you are not logged in or do not own the site, you will not be able to see any UUIDs or upload any data files. Each individual UUID can be quickly copied by hovering your mouse over the value and clicking on it. Note that the registration token is not needed to upload csv files. That value is only needed to post live data.

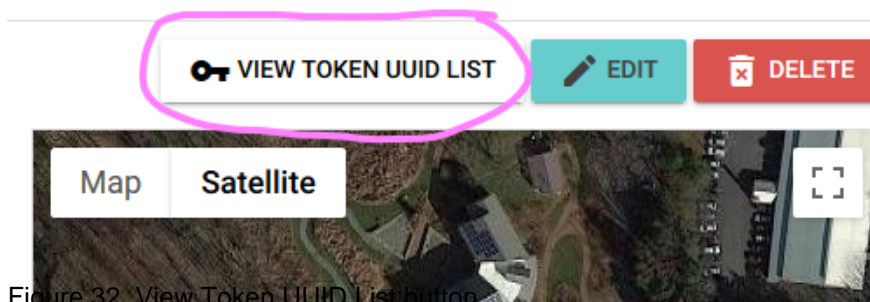
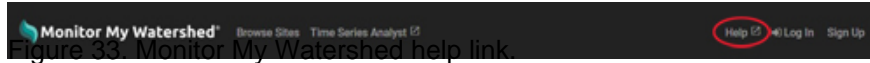


Figure 32. View Token UUID List button.

8. Add your data below the header.
5. Here is [an example](#) of a file ready for upload. *Remember, if you view this CSV file in Excel, the timestamp will be automatically converted and will no longer be in the correct format!*
6. Upload the file to your site by selecting "Manage Sensors" in the Sensor Observations section of your site page and clicking on the paper clip button below the list of variables. Navigate to and select your file and then click "upload."
 1. The maximum size for a single file at this time is only 1MB. If your file is bigger than that, you will need to break it into multiple files.
 2. After you click the upload button, it may take some time for the file to be processed. A pop-up will appear at the bottom of the page and you will receive an email with the processing finishes.
 3. You should be able to see the uploaded data immediately after the processing finishes on both your site page and in Time Series Analyst.

8. Additional Help

Additional help for Monitor My Watershed can be accessed using the **Help** link found on the top menu bar (Figure 33).



Clicking the Help link takes you to the WikiWatershed.org Help page. This page displays help resources for all of the tools in the WikiWatershed Toolkit. For sensor data help resources, scroll to the Monitor My Watershed/EnviroDIY box and click the “View Help Resources” button (Figure 34).



Figure 34. Link to Monitor My Watershed/EnviroDIY sensor data help resources.

Once you are on the sensor data help page, you will see a list of all of the help resources for using Monitor My Watershed to view and share sensor data, including a Model My Watershed Quick Reference Guide, two tutorial videos, and the link to this manual.

You will also see how you can ask for help on the EnviroDIY.org forum and how you can use GitHub to search for known issues and report new ones.

9. Ask a Question

Before submitting a question by email, please do the following:

- Search the [EnviroDIY forums](#) for similar issues. If you don't find the answer, try posting your question on the forum to allow EnviroDIY community members to help.
- Check our [GitHub issue tracker](#) for known issues and [GitHub milestones](#) to see scheduled bug fixes and feature additions. GitHub users are welcome to report problems in the [issue tracker](#).

If you've reviewed this document, searched the EnviroDIY forum, checked GitHub, and still have a question or issue, please submit it on the Contact page (<https://wikiwatershed.org/contact/>). For the “What do you need help with?” question, be sure to choose “Monitor My Watershed/EnviroDIY Sensor Data.”

10. Credits



Monitor My Watershed® is part of WikiWatershed®, an initiative of Stroud™ Water Research Center (<https://www.stroudcenter.org/>). The Stroud Center seeks to advance knowledge and stewardship of freshwater systems through global research, education, and watershed restoration.

Collaborating Organizations

- [LimnoTech](#)
- [Utah State University](#)

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11. Send Us Feedback

Please help us improve this guide. You can leave feedback by looking for the “Was this helpful? Yes or No” text at the end of each section. If your answer is no, or if you see something that needs to be changed, please use the “Suggest an edit” link and fill out a quick form.

Your feedback will not be displayed on the webpage but will be emailed to the webmaster.

Additional resources can be found on the [WikiWatershed help page](#).

Appendix D

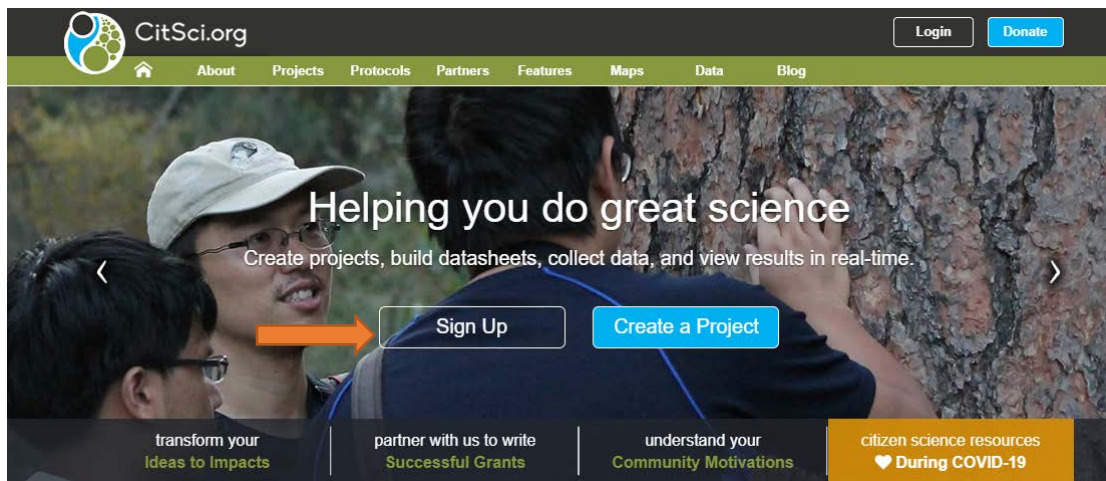
Logging QC Data on Citsci.org



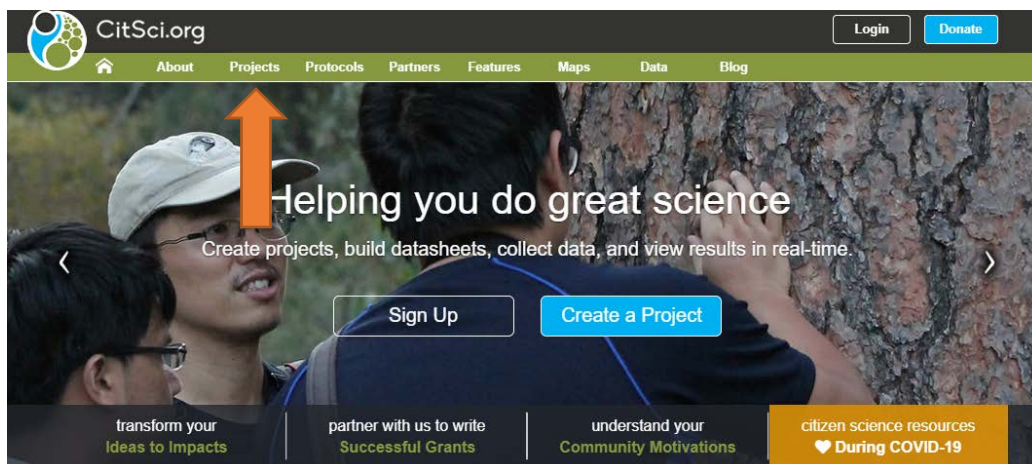
Quick Guide: Logging QC Data on www.citsci.org

Joining Mayfly Sensor Station Project on CitSci

- Navigate to www.citsci.org. Click “Sign Up”.



- Create username and password.
- Check your email to verify your email and complete your registration
- Navigate to citsci.org on a web browser, sign into your account and click “Projects” in the top navigation bar.



- Search “Mayfly Sensor Station”
- Click “Ask to Join”

The screenshot shows the CitSci.org website with the 'Projects' section. A search bar at the top left contains the text 'Mayfly Sensor Station'. To the right of the search bar is a 'Show' dropdown menu set to '10' and the word 'entries'. Below the search bar is a table with columns: Photo, Project Name, Description, Start Date, # Measurements, and Options. The first row of the table shows a photo of a fish, the project name 'Mayfly Sensor Station QC Data', a description 'Quality control data for Mayfly Sensor Stations. Stations maintained by Trout Unlimited and partners. View ...', a start date of 'March 3, 2020', and an 'Options' column with an 'Ask to Join' button. An orange arrow points to the 'Ask to Join' button. Below the table, it says 'Showing 1 to 1 of 1 entries (filtered from 917 total entries)'. On the right, there are 'Previous', '1', and 'Next' buttons.

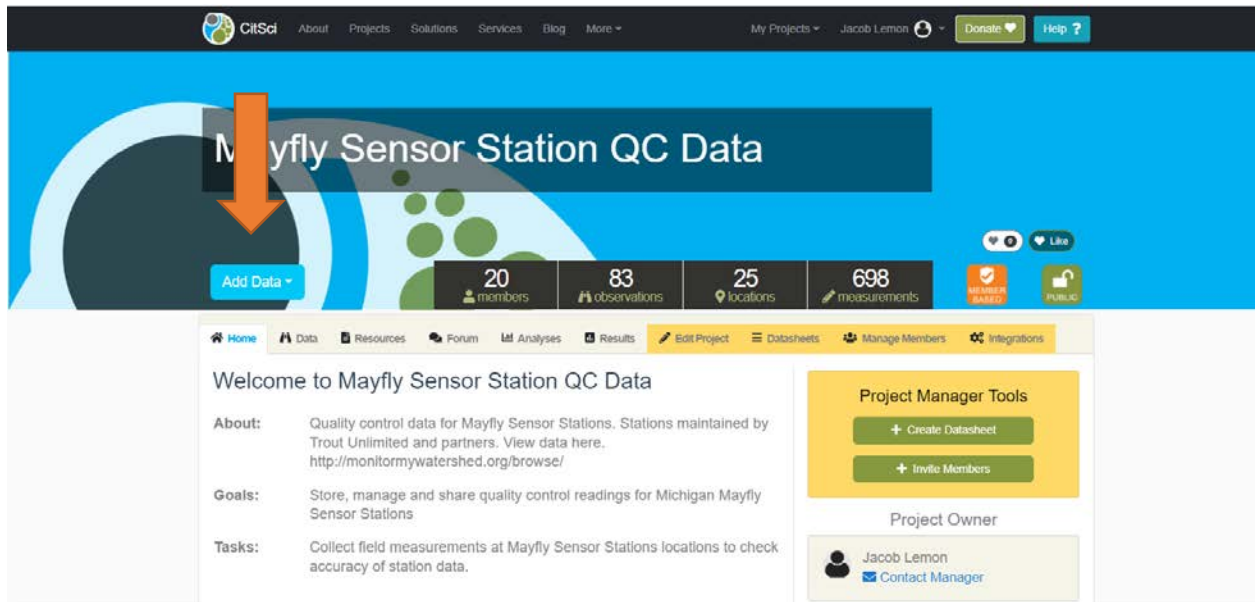
- Choose “Contributor” for Requested Role
- Accept Agreement
- Click Submit
- You will receive an email when you are approved as a contributor

Logging Data on CitSci on a desktop computer or laptop

- Sign into www.citsci.org
- Click “My Projects” on the top right and navigate to “Mayfly Sensor Station QC Data”

The screenshot shows the CitSci.org homepage. At the top, there is a navigation bar with the CitSci.org logo and a menu: About, Projects, Protocols, Partners, Features, Maps, Data, Blog. On the right side of the navigation bar, there is a 'My Projects' dropdown menu, a user profile 'Jacob', and a 'Donate' button. An orange arrow points from the 'My Projects' dropdown menu to the 'My Projects' text. Below the navigation bar is a large banner image showing two people looking at a tree. The banner text reads 'Helping you do great science' and 'Create projects, build datasheets, collect data, and view results in real-time.' Below the banner are two buttons: 'Sign Up' and 'Create a Project'. At the bottom of the page, there are four columns of text: 'transform your Ideas to Impacts', 'partner with us to write Successful Grants', 'understand your Community Motivations', and 'citizen science resources During COVID-19'.

- Click the blue “Add Data” button. Then click “Mayfly Sensor Station Quality Control”.

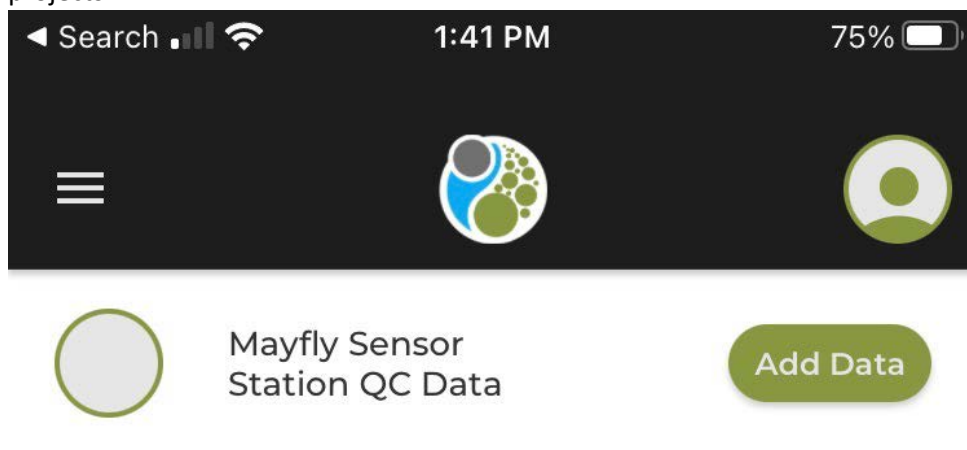


- Fill out form and click “Submit”


Note: There are two options for depth cross check (gage staff and rebar pin). You will only enter one of these values, depending on the method for cross checking depth at your site. Leave the other option blank.

Logging Data on CitSci mobile application

- Download CitSci app
- Login to account
- Once you have joined the project “EnviroDIY Sensor Station QC Data” will be in your list of projects.



- Click “Add Data”

- Enter QC Data
- Save observation
- If you have cellular data signal click “Go to Upload”
- Click the black upload icon  to submit your data.
- If you do not have cellular data signal at the site click “OK” after saving your observation.
- Later when you are connected to WIFI or have cellular data signal click the expandable navigation menu on the top left and choose “Observations to Upload”. Click the black upload icon to submit your data.